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THE CASE FOR THE COMMON LEARNINGS COURSE

HAROLD C. HAND

University of Illinois, Urbana, Illinois

THE case for the "common learnings" course is, in my opinion, unassailable. The argument can be simply, though not briefly, put. It runs somewhat as follows:

We start with a two part premise, the validity of which is beyond dispute: (1) That it is the responsibility of the secondary school to aid society in carrying on the basic social processes which can be neglected only at the certain cost of societal retrogression and decay, and (2) that it is also the responsibility of the secondary school to nurture youth in reference to all types of wholesome growth—to aid them in performing their developmental tasks and in meeting their other practical problems of "getting along" in an adequate manner. It might be added that this second responsibility can be neglected only at the certain cost of personal inadequacies (and consequent frustrations) in the pupils supposedly being "educated" by the school.

Let us make more specific each of these two responsibilities, in the order named.

If it is to escape commitment to the wastebasket of history, any given society in any given time or place must successfully carry forward certain basic social processes. It must enable its population to make a living. It must provide physical security for its members (in our time, this means guaranteeing the peace). It must keep its population healthy and vigorous, and safeguard its members against accidents and disease. It must develop, wisely utilize, and conserve its natural resources. It must rear and educate its young. It must enable its population to satisfy its spiritual and aesthetic impulses. It must provide recreation for its members. It must provide sufficient "social cement" (a body of commonly held beliefs and aspirations) to afford societal integration. And it must so organize and govern its population that all the other processes will successfully be carried forward in consonance with its commonly held beliefs and aspirations.

It can easily be demonstrated that the successful carrying forward of any of these basic social processes requires *learned behavior;* that each requires that the population must *understand, believe,* and *do* certain things rather than their opposites; hence, that the effective discharge of any and all such survival imperatives is a function of education. That only artifacts remain to remind us of some of the world's once great cultures attests the antecedent fact that their educational "systems" were inadequate to the operational demands of one or more of these necessary processes. What the bearers of these now defunct cultures needed to *know, believe,* and *do* in order to insure societal survival was *not* effectively educated into their nervous systems. As we have already noted, the societal consequence of such educational inadequacies is inevitably a regression through stagnation and decay to ultimate liquidation.

We turn now to a brief particularization of the second educational responsibility postulated by our premise—that of enabling all youth to achieve personal adequacy in terms of life's demands upon them.

As we have already suggested, one cate-

gory of personal need in this regard derives from the fact that youths face certain demands imposed by our culture — tasks which our society requires that youth must either perform successfully or be penalized or punished. These penalty-frightened demands begin to impinge upon the child in early childhood and continue to do so on through adolescence and adulthood until senility wins him his reprieve. Corey and others have dubbed these the "developmental tasks" (of childhood, of adolescence, of adulthood), and this aptly descriptive appellation promises to "stick."

What concerns us here are the developmental tasks of adolescents. These Corey has defined as (1) coming to terms with his own body; accepting his own body in terms of its size, shape, and rate of growing; accepting his own sex with its characteristic privileges, responsibilities and limitations: (2) achieving a new orientation to his age mates of both sexes; to learn to deal with his fellows as equals; to meet those of the opposite sex on equal terms, and eventually choose one for a husband or wife: (3) achieving independence from his family; to free himself from his dependence on his parents; ultimately, to be sufficiently "psychologically weaned" from his family to become an adequate partner in establishing a new family: (4) achieving adult economic and social status; acquiring the ability to hold down a job; putting aside childish ways and accepting responsibility as a citizen: (5) acquiring self-confidence and a system of values; becoming a mature person as our culture defines the term.[1]

As we note this list of developmental tasks, it is apparent that each requires the learning of new attitudes, the acquiring of new understandings, the building of new skills, and the engendering of new modes of behavior—*learned responses* all. The successful performance of each developmental task is thus a function of education. Either the adolescent learns what must be learned, or he fails to achieve the developmental adjustments which these tasks connote. One has but to reflect on the penalties certain to be imposed upon any boy or girl who fails in this regard to appreciate how imperative it is that the secondary school build into the nervous systems of youth the requisite understandings, beliefs, and pre-dispositions to behavior.

There are many types of practical help which youth need in order to "get along" adequately. Most of these are directly related to the developmental tasks just discussed, but all are needed if the boys and girls are to make the most of their lives. Each of these types of help is completely educational in nature, as the following partial list will demonstrate: Securing needed vocational information, help in choosing an appropriate occupation, securing needed vocational training, help in choosing appropriate school subjects and student activities, help in deciding whether or not to go to college or a trade or other vocational school, help in choosing such a school should the decision be to go, learning how to get a job, help in actually getting a job, learning how to buy wisely, learning how to prevent accidents and care for one's health, learning how to improve one's personal appearance, acquiring the good manners associated with poise and self-confidence, learning how to get along happily and effectively with other people, acquiring good work habits and learning how to "stick to" a job, learning how to communicate (speak, write, read, listen) more effectively and enjoyably, learning how to select and to enjoy good books, newspapers, magazines, motion pictures and radio programs, learning how to sing or play a musical instrument and to enjoy good music, learning some handicraft or other enjoyable manual skill, learning enjoyable games and sports, developing a hobby, developing intellectual interests and

[1] Stephen M. Corey in H. L. Caswell and Others, *The American High School*, and in B. Lamar Johnson and Others, *General Education in the American High School*.

becoming a more cultivated person, becoming literate in reference to community, national, and world problems and developing the interest and ability to participate in resolving them, and preparing for a happy marriage, intelligent home management and wise parenthood.

Unless our educational program is to be of the ivory tower variety, all of the learning experiences connoted by these practical life-needs of youth must be provided by our secondary schools.

Perhaps we have said enough to demonstrate the validity of the two-part premise with which we began; namely, that it is the responsibility of the secondary school (1) to aid society in carrying forward the basic social processes essential for societal survival and (2) to give all the types of practical help which youth need in order to "get along" adequately. At any rate, we shall rest this part of our case at this point.

The next part of the case for the common learnings course will consist of a demonstration of the fact that *both* of these two responsibilities are seriously neglected, and inevitably so, by the traditional broad field area approach (the curriculum structured as English, social studies, science, mathematics, modern languages, etc.—the traditional subjects of "general education").

Let us first note some of the evidence bearing on the established fact of this neglect. The most biting general appraisal is that made by the Educational Policies Commission:

> "Setting: A democracy struggling against strangulation in an era marked by confused loyalties in the political realm, by unrest and deprivation, by much unnecessary ill health, by high-pressure propaganda, by war, by many broken or illadjusted homes, by foolish spending, by high crime rates, by bad housing, and by a myriad of other urgent real human problems. And what are the children in this school, in this age, in this culture, learning? They are learning that the square of the sum of two numbers equals the sum of their squares plus twice their product; that Millard Fillmore was the thirteenth President of the United States and held office from January 10, 1850 to March 4, 1853; that the capital of Honduras is Tegucigalpa; that there were two Peloponnisian wars and three Punic wars; that Latin verbs meaning to command, obey, please, displease, serve, resist, and the like, take the dative; and that a gerund is a neuter verbal noun used in the oblique cases of the singular and governing the same case as its verb." [2]

That this impressionistic appraisal is probably uncomfortably close to the mark is attested by the findings of the New York Regents Inquiry, a study in which the investigators went directly to school—leaving youth to find out what they believed, knew, and did. It was found that the high school characteristically gave little or no help to these youth in finding jobs, that these pupils typically had educational and vocational plans which were strikingly unrealistic, that they showed little discrimination in selecting radio programs and motion pictures, that they voluntarily read little other than mediocre books—and very few even of these, that they were seriously deficient in their knowledge of the facts and problems with which citizens should be concerned, that they were uninformed about social conditions even in their own communities, that they had little tolerance for new ways of dealing with social problems, and that the longer they had been in school the less disposed they were to do anything for the common good.

The boys and girls in this study were, however, found to be reasonably well-acquainted with the standard school selections such as "The Raven," "Quentin Durward, and Cooper's stories about Indians—a finding which gives further damning point to the acid characterization by the Educational Policies Commission.

Another very distressing finding was that most of the youth did *not* regard the school as a place where one got help with any of life's real problems.

In summarizing, the Director wrote in part as follows:

[2] Educational Policies Commission. *The Purposes of Education in American Democracy*, p. 147.

"The average New York State high school is now geared to do one kind of a job, and only one. It takes the boys and girls who are fed into it . . . and starts them on a four-year round of drill and memorization. . . . The examinations have little to do—directly, at least—with the abilities which boys and girls need outside of school. . . . Nor does the school's method of preparing for the examinations have any direct relation to out-of-school matters. . . . It fixes its attention on a kind of performance which has little meaning except in academic circles. . . . They (the schools) fail to make their pupils ready for definitely predictable out-of-school requirements and opportunities, chiefly because they do not systematically concern themselves with any such matters." [3]

There is, of course, no good reason for supposing that the secondary schools of New York State are any worse than those of most other states. This generalization is borne out by the disturbing findings of a study conducted by the present writer in another state. This study embraced all the seniors in 15 high schools, and as many of the recent graduates of these schools as could be induced to participate in the study. Each pupil and ex-pupil was asked to tell how much help he had received from his school in reference to some 35 types of practical real-life needs. Included among these types of needs were all of those utilized for illustrative purposes in the tenth paragraph of this article. For neither group was the average of the ratings for all types of help combined higher than that section of the scale labeled "some help, but not sufficient." In reference to but one type of help did these young people say that they had received "considerable, but not sufficient help." Not a single item was rated "sufficient help" by either group.[4]

No study in which the investigators actually went to the pupils has been reported which gives one any reason for believing that the appraisals noted in the preceding paragraphs are invalid for the generality of American high schools. On the contrary, other studies in which the investigators did go to the pupils and which support these distasteful generalizations could be placed in evidence here if space permitted.[5] What this all adds up to is the fact that our reliance upon the traditionally structured high school curriculum—i.e., upon English, social studies, science, mathematics, etc., taught as separate subjects or broad field areas—has resulted in a gross neglect of the two basic responsibilities laid down as "musts" in our premise.

Now let us examine *why* it is that we get these unfortunate results.

In the first place, the traditional subjects were never designed to meet either of the two responsibilities noted in our premise. Instead, each is organized according to its own inner logic. This logic is but little concerned with either of the two responsibilities noted. The essence of these two responsibilities is the resolving of real-life problems, societal and personal, whereas the inner logic of the traditional subjects permits such real-life problems to be treated but *incidentally,* if at all. The skeptical reader is urged to consult virtually any standardized test in any of these traditional subject areas for verification. Or he might scrutinize any one of the National Teachers Examinations.

In consequence of this conflict of inner logic—i.e., the inner logic of real-life-problem-solving vs. the inner logic of standard subjects which at best admits of but incidental attention to such problems—efforts to "functionalize" the traditional high school subjects invariably and inevitably result in asking the teacher simultaneously to serve two contrarily-oriented masters. That this is frustrating in the extreme, there can be little doubt—as any number

[3] Francis T. Spaulding. *High School and Life,* pp. 252-3.

[4] College of Education, University of Maryland. *A Program of Reorganization for the Public Secondary Schools of Prince Georges County, Maryland,* p. 24-5.

[5] See, for example, Howard M. Bell, *Youth Tell Their Story,* and G. N. Kefauver and H. C. Hand, *Appraising Guidance in Secondary Schools.* See also any work dealing with current social problems (divorce, crime, juvenile delinquency, natural resources, etc.)

of intelligent and conscientious teachers will testify. What is more important, the traditional master almost invariably wins out in this unhappy and unequal struggle —to the educational neglect of society and youth, as we have demonstrated. If the course is labeled "English," or "social studies" or any other name identified with a recognized body of more or less standard subject matter, the teacher is conscience-stricken unless he gets across at least a respectable minimum of whatever this subject matter may be. This he will usually do regardless of the fate of the problems with which he is also supposed to be dealing. But this neglect of problems also induces feelings of guilt, it must be recognized. What this adds up to is scarcely a recipe for good mental health.

Let us suppose, however, that by some magic this conflict of inner logics could be resolved and that every one of the traditional subjects or broad field areas could be 100% functionalized. Even with such a program of 100% functionalized subjects, it would still be impossible for any school to discharge either of the two responsibilities noted in our premise. This would be true because no societal or youth problem of any real significance can be understood, much less resolved, by appeal to the resources which any one of the subject matter fields could afford. Instead, every such problem requires various of the resources of several of the usual subject fields plus certain others not afforded by any broad field area now included in the high school curriculum. Let the skeptical reader take any important real-life problem he chooses and in terms of subject fields trace out what it would take to make youth even literate in reference to the problem. Then let him note what it would take to equip youth to effect the individual and/or social action necessary to resolve this problem.

From what has just been noted, it might mistakenly be assumed that the two basic responsibilities laid down in our premise could be discharged if two, three, or more of the traditional subjects were combined in some manner and teams of say English, social studies, and science teachers were to instruct jointly. This brings into conflict not two but eight inner logics; namely, that of English vs. that of social and personal problem solving, social studies vs. problem solving, science vs. problem solving, English vs. social studies, English vs. science, and social studies vs. science. So long as there is any presumption that respectable minima of English, social studies and science will be taught in such hybrid situations (in schools where this type of programming is practised the work is not uncommonly separately recorded in the front office as English, social studies and science), the stage would appear to be set for teacher vs. teacher as well as standard subject matter vs. problem solving conflicts of no inconsequential order. We are guilty of understatement when we say that this does *not* appear to be the way to meet the twin responsibilities laid down in our premise.

Nothing remains except to provide in each year of the high school a required offering which makes a *direct* attack on societal and youth problems, which has no responsibility other than this, which is called by a name in no way identified with any existing body of standard subject matter, and which utilizes whatever resources it takes to do the job. This is precisely what is connoted by the term "common learnings course" as employed in this paper.

Of what "whole" should this new offering be a part? In other words, what would the total operating program of the secondary school which included such a required offering look like? Here is the "total picture" as it is visualized:

1. Common Learnings Course
   Two hours per day in all secondary school years through grade eleven. One hour per day in grade twelve. Required of all pupils.
2. Health and Physical Education Activities
   One hour per day in all years. Required of all pupils.
3. Standard Specialized Subjects (English,

biology, mathematics, vocational courses, etc.)
Elective under guidance except in exceptional cases. Required only on the basis of demonstrated pupil-need in individual cases.

4. Guidance and Personnel Services
(What is ordinarily called group guidance would be included in number one above). Special provisions as needed for exceptional pupils. Testing program. Counseling of referrals. Record keeping and reporting.
5. Activities Period
One hour daily, alternately given to clubs, assemblies, intramurals, band, orchestra, glee club, etc.

Before turning to a somewhat detailed discussion of the common learnings course, it might be well to lay one ghost to rest. From the earlier discussion some of our readers may have been led to believe that we see no value in the standard subjects of the high school. This is not true. We believe that every pupil will have various special interests and/or needs which can best be met through specialized courses. To illustrate, many pupils have vocational needs which can only be met through various types of vocational courses. College preparatory pupils variously require highly systematic courses in science, mathematics, social science, foreign languages, and English which are geared to their needs and higher level of capabilities. Other pupils have non-college preparatory interests in these and other specialized subjects, and so on. Our apparent cavil against the standard subjects is more apparent than real. What we have by inference complained about above is rather the fruitless attempt to make these subjects serve basically important purposes which they were never intended to meet and which they can never adequately fulfill except as the pursuit of the values which they severally typify is abandoned. Clearly, the question is *not* whether we should have the common learnings course *or* specialized subjects. We need *both*.

Let us now become a little more explicit about the common learnings course. This required offering would be completely problem-centered, and the problems treated would in every instance be real. Although they would necessarily have to be respectably literate in reference to these problems in order to guide youth effectively, neither the teachers nor anybody else would know the final "answers" or "solutions" to any of the problems dealt with.

The "content" of this course would derive from (1) the unresolved problems variously associated with the effective carrying out of the basic social processes essential for societal survival, and (2) the common real-life personal problems of the youth group in question.

In reference to the first type of "content," the school would obviously have to restrict its choice to those which it believed to be most important, then narrow this selection still further to include only those which the maturity levels of the various grade groups would sanction as sensible to attack. Each category of societal problems to be included should first be broken down into meaningful wholes (parts), and each such meaningful whole problem (part of a more inclusive problem) first assigned to the grade level at which it is sufficiently within the experience of the age group in question to justify its consideration by pupils in that particular grade. Serial consideration at different grade levels should be provided as necessity or desirability might warrant.

The second type of "content" should be selected in a similar manner. The commonly experienced real-life problems of the pupils in question should obviously be placed at the various grade levels corresponding to the age groups to whom they first became real. Time limitations would undoubtedly force the school to be selective —obviously, those problems deemed most important should be scheduled for attack in preference to those of less significance in the lives of youth. Serial treatment of these more important problems should be provided to the extent and at the age levels deemed necessary or desirable.

In sum, so far as the maturity of the pupils and the time available would permit, all of the meaningful components of each

major problem category which should be included in the common learnings course would thus be allocated to one or more grade levels. What we have outlined is simply a common sense plan to guarantee that no important societal or personal problem will be omitted unless ruled out by considerations of lack of time or inadequate pupil maturity, and to insure so far as possible that all problems which are included will be meaningfully treated.

That the common learnings course calls for a new type of teaching means among other things that certain steps must be taken to safeguard the psychic security of the teacher. One essential safeguard is to assure that no subject-matter-expectation club be permitted to hang over his head. The other requisite has to do with instructional materials. To force or even to permit a teacher to embark upon this type of teaching without adequate teaching materials is to court disaster both to the course and to the teacher's emotional health. A resource unit must be constructed (or adopted or adapted if already available) in reference to each problem or problem-cluster selected for inclusion in the course. In the construction of each resource unit, teachers from all broad field areas should participate in defining the behavioral statement of objectives to be striven for, in designing a rich variety of suggested learning experiences geared thereto, and in building a list of fruitful teaching-learning materials.

Because this is a changing world, and because this course is designed to make pupils literate in reference to the more important unresolved problems of such a world, the common learnings course must undergo continuous revision. As societal changes occur and new problems emerge, these must be included. As old problems are resolved, these must be dropped. These changes necessitate the building of new resource units and the abandonment of others. And as the character of the pupil population changes—or as the conditions which the pupils confront change—, new commonly experienced personal problems will emerge and old ones drop out of the picture. Again, new or revised resource units should mirror the changed needs.

We shall conclude with a few words epitomizing the potential significance of the common learnings course. Never in history has so much hinged on the race between education and catastrophe. Seldom, if ever, has education been so out-distanced by its frightful competitor as it now so clearly is. Either those who educate must quickly succeed in creating many types of new mind (new attitudes, beliefs, understandings, skills, and pre-dispositions to behavior) or man will become the victim instead of the master of the urgent problems he now confronts both at home and abroad. In such a context, the common learnings course (already established in embryo form in some schools) may easily prove to be the most important social invention in the history of secondary education to date.

THE SOCIAL SIGNIFICANCE OF SCIENCE

JOHN BREUKELMAN
Kansas State Teachers College, Emporia, Kansas

THE Social Significance of Science—this is a common topic these days in both the scientific and the popular press. Much of the writing deals with special or superficial aspects, relatively little with the underlying fundamentals. No matter what their approach, the writers agree on one point: scientific progress is a necessity in a democracy which finds itself in a position of world leadership. If this is true, then it is self-evident that the agencies of science must have the intelligent support of the majority of its citizens, because in a democracy the citizens and not the scien-

tists determine, through their votes and in other ways, what is to be done about science. Votes reflect public opinion, which is made by education, and this is where science teachers come in.

This complicated business that we call science has two important aspects. We commonly know them as pure and applied science. Pure science is a search for truth and thus provides sources of knowledge. Secondly, science can be applied so as to change the living conditions of human beings. Endless confusion exists between our understandings of these diverse phases of the same activities. The source of the confusion is not hard to find—the two phases overlap each other and many individual scientists are engaged in both of them. For example, a biologist who spends most of his time in the pure-science study of the microscopic structure of fish scales may at the same time be applying knowledge gained by his study. He may be attacking problems of fish growth with an ultimate view toward the improvement of fishing in a certain group of lakes.

For clarity of understanding we may better classify the activities of science not into two but into three areas. They are not mutually exclusive, but do represent in a general way the areas in which persons with training in the sciences may be working. There are pure science, applied science, and technology.

1. *Pure Science.* This is fundamental research for the sake of understanding nature, with no practical objective consciously in view. Such was most of the work of Mendel in biology, Maxwell in physics, Gibbs in chemistry, and many others whose names stand high among the pioneers in the sciences. They asked "What can we find out about this?" rather than "What can we do with this?" It is this type of research of which the layman is apt to say "What's the good of this?" or "What difference does it make how many bristles this bug has on its thorax?" or "When you have split an atom, just what the hell have you got?" Even the scientist himself cannot answer these questions except to say that this type of research furnishes the basic knowledge for all other scientific progress—not a very satisfying answer to the layman.

2. *Applied Science.* This is research that has a practical objective, either immediate or remote. The applied scientist seeks to control nature, not, as in the preceding case, to understand nature. Much of the research in soil science, animal breeding, disease control, meteorology, industrial physics, chemistry and geology is of this type. Pure and applied science use the same methods, materials, language and concepts. There are no differences in training, organization or competence of workers. Individuals working in one may sometimes be even more interested in the other. To be sure, the basic difference in the aims and objective results in differences in outlook and orientation which may be far-reaching in their practical implications for the future of citizens in a democracy. But there are few if any pure scientists so pure that they are not interested in applications of their research. A pure science discovery may be applied in another area even while the original work is still going on, as in the case of penicillin.

3. *Technology.* It is here that the nub of the problem comes. This is the use of knowledge (gained by pure or applied science) in developing and practicing techniques for the solution of immediate problems. The aim of technological research is the application of knowledge for extra-scientific purposes. Usually a technologist's problem is assigned to him and he is expected to provide a solution. This kind of research is based upon scientific understanding but contributes to it only incidentally if at all. In science, an experiment which does not lead to new understandings is a failure—technology is not basically experimental at all, except as all trial and error procedure is experimental. The technologist is not less intelligent or ingenious than the scientists, but he is

engaged in fundamentally different activities. Technology omits large areas of fundamental concern to science. For example it touches very lightly taxonomy, astronomy and many other of the more abstract phases of science, because these do not offer the promise of handy techniques for immediate use.

These differences of aims and fields of interest cannot be disregarded without losing sight of the real problems involved in the social function of science. Failure to distinguish between pure and applied science does not matter so much as noted above, they overlap to a considerable degree and sometimes the distinction between them may be almost academic—but to confuse science and technology renders impossible clear thinking in the significance of science and the scientific method.

For example, the radio, cotton gin, and automobile were technological advances; the scientific principles on which they were based had been known for decades and even centuries before their appearance. Indeed the atomic bomb, which was hailed by the public press (and unfortunately sometimes even by the scientific press), radio, pulpit and lecture desk as the greatest scientific advance since Newton's Laws, the evolution principle or what-not, was strictly technological, according to the statements of the men who made it. Many of the scientific principles on which it was based had been known since the nineteenth century and all of them since before we entered the war. Indeed the scientists responsible for its production report that even most of the actual techniques were developed before 1939.

A great deal of the modern writing about science is really about technology. There is much truth in the remark that we live not so much in an age of science as in an age of gadgets. This is not to say that technology is unimportant—it is absolutely essential to our way of living. But it is to say that while technology is important, much more important is the science which makes technology possible. The place of science in society is one thing; the place of technology in society is another and a quite different thing. Scientists can speak with special competence concerning the former; about the latter they can speak only as well-informed citizens.

Not only is it necessary to distinguish pure science, applied science and technology; it is likewise important to erase some false distinctions which have been made within these areas. One science is not more exact or more stable or more objective than another. To be sure, there are differences in the extent to which certain of the sciences have been reduced to mathematical statements or in the extent to which workers within a field tend to agree on major theories. There are "young" and "mature" sciences, and the various "ologies" have life cycles. But it seems silly to say, for example, that psychology or sociology lack precision because an observer cannot tell how an individual person will react—even in our most "exact" science, the physicist cannot tell what an individual electron will do. In discussing the social significance of science, the emphasis should be placed on the similarities, for the fundamentals are the same for all the sciences. All science is based on experience, interpreted by reason; all science is a constantly developing interplay of experiment and theory; all science is based on personal integrity which requires complete objectivity of attitude and freedom of thought, investigation and publication. If the investigator is not strictly objective in attitude and scrupulously honest in reporting he is simply not a scientist; whether he happens to be dealing with test tubes, guinea pigs, voltmeters, I. Q.'s or tax rolls is immaterial.

Science may not be the sole and universal way of arriving at truth, although many people write and talk as though it is. Be that as it may, while the prestige of science is as high as it is now, scientists and science teachers have a special responsibility and a special opportunity to foster scientific thinking about the place and significance

of science in the present and future world.

One of the most frequently discussed phases of this entire problem is that of planning the nation's program of scientific development. Planning in *science* is almost, if not quite impossible. The end and goal of science is knowledge. It must follow all trails or it may miss the most significant ones. It cannot be directed by any authority outside of the trails themselves. An attempt at direction usually results in deterioration in work already under way, as in the case of genetics in Hitler's Germany. Even in the totaiitarian Russia of the Czars and the Politburo, fundamental scientists have apparently been given complete freedom to pursue whatever lines they think will be fruitful, or whatever lines they feel may become so.

Planning in *technology*—in disease control, in national defense, in industrial development—can and must be directed. The controlling authority must, in a democracy, come from the people themselves through the regular channels of education and legislation. Therefore, understanding is of the utmost importance.

The essential fact to note is that technology is the cart—science is the horse. Or to change the figure, the stream of technology flows from the spring of science. In a democracy the citizens must keep the spring flowing. If they do not, the spring will dry up and there will be no technology to direct. In the rush of great technological advances, there is danger that fundamental science may be overlooked. Tomorrow's need is for that ever-increasing knowledge which grows from exploration of all frontiers. This the people cannot direct, but for it they can and must provide increased facilities.

From a long-time standpoint, in this area lies one of the deepest responsibilities of science teachers. Whether they know it or not, teachers are among the most important manufacturers of public opinion. Obviously it is only through enlightened public opinion that people in a democracy can provide unrestricted facilities for expansion of scientific knowledge in all directions.

PROGRAM OF SPECIALIZATION IN ELEMENTARY SCIENCE

BEGINNING in the fall of 1948, the New York State College for Teachers at Buffalo will institute a special program designed to train elementary teachers with a special competence in the field of elementary science.

This specialization has been set up in response to a very definite need. Thus, a committee of the New York Association of Elementary School Principals in summarizing 620 questionnaire returns from elementary schools of the state, reports that virtually all schools have an elementary science program of one sort or another, a program taught in most cases by the classroom teacher, herself. However, the principals are apparently not completely satisfied with these programs, for this same report states that the greatest obstacle to more and better science is "lack of teacher education in science." One solution to this problem is evidently more science for all general elementary teachers. Another solution would seem to be to give a certain portion of the group of general elementary teachers-in-training a rather extensive, although broad, program of science courses. Such persons would still be elementary teachers but because of their special interest and competence would serve to better the science programs of schools into which they go, through aid they may give to other teachers as well as through work in their own classrooms. The specialization program at Buffalo is designed to train persons of this sort.

The program is set up within the framework of the existing general elementary

curriculum. In September, 1948, and each year thereafter it is planned that one section of the sophomore class will be formed of persons who have been admitted to the program. The exact sequence of science courses to be taken by any individual will depend in part upon the science preparation, but a typical program would include: a year, each of physical science survey and biology; single semester courses, *Science in the Elementary Grades* and *Field Course in Science;* electives in science to round out the program. The practice teaching experiences of this group will be planned to include situations where a good elementary science program is under way. By utilizing the electives in the present general elementary program, this science specialization may be followed without disturbance of the requirements in the present four-year curriculum. Hence, and desirably, the graduates in this special program will be elementary teachers with a special interest and competence in science, rather than subject-matter specialists who happen to teach in the elementary school.

Persons interested in obtaining further details should write:

H. EMMETT BROWN
Professor of Science
New York State College for Teachers
Buffalo 9, New York

A SUBSTITUTION FOR THE TERM "EXPERIMENTAL METHOD" AS USED IN INVESTIGATIONS IN SCIENCE EDUCATION

PAUL F. BRANDWEIN
Forest Hills High School, Forest Hills, New York

As one reads accounts of investigations in science education, one is struck by the use of the term "experiment" and "experimental method" in the elaboration of curricula or courses of study. Close study of the reports in which these "experiments" are discussed shows that they are not experiments in the sense that scientists accept the term. They are, instead, recognizable by the improvisation which distinguish "trial and error" methods. For one, controls are lacking; second, it would be difficult to duplicate the conditions of the "experiment" even if the operations used were carefully described in the greatest detail. It is clear that what these writers term "experiments" are really experiences whose results may not be transferable to other situations.

It is proposed, therefore, that where reports deal with experiences of the sort indicated above that the term "experiential method" be used or the term "experimental method" be initially defined. This is not to deny the value of work done by the experiential method. Where the worker is a trained and critical observer, the method will yield, as it has always yielded, valuable data. Possibly the basic elements of the situation he experiences may be transferable to similar although not identical situations.

In any event, this is no attempt to introduce a new term into an already overweighty vocabulary. It is an attempt at clarification rather than obfuscation. Whether this suggestion is acceptable or not, there is a great need for those groups interested, especially the National Association for Research in Science Training to consider seriously the need for standardizing the use of terms which are at the core of investigational work in science teaching.

USING COMMUNITY RESOURCES IN THE EDUCATION OF NEGRO TEACHERS *

EDWARD K. WEAVER

State Teachers College, Montgomery, Alabama

FOR some time there has been need to investigate the program of teacher education in institutions preparing Negroes for teaching. The very nature of the bi-racial and segregated pattern in the United States isolates the Negro people, and demands that Negro teachers develop special skills, abilities, attitudes, and competencies for utilizing community resources in solving the special problems of the Negro people. There is need to gain special competence in dealing with the socially significant and controversial issues which are a part of everyday living as a Negro in the United States. These socially significant controversial issues lie in areas to which science education has a great contribution to make.

The segregated Negro colleges in the South are specifically chartered to train teachers for the segregated schools in the various southern states. These colleges often fail to provide teachers with techniques for integration of the Negro people within the cultural pattern. Negro teachers develop these techniques, if, indeed, they develop them at all, outside the formal educative process.

A persistent trend in education has been to bring the school and community closer together so that the social, human, and natural resources may be better utilized in solving the problems of all the people. But the efforts of the Negro people to fuse themselves into the life of the community is in basic and fundamental conflict with the prevailing cultural pattern, for the prevailing cultural pattern is designed to isolate the Negro people, and to keep them from full integration into all aspects of community life.

WHAT DO NEGRO TEACHERS KNOW ABOUT THE COMMUNITIES IN WHICH THEY TEACH?

A study was made to ascertain the extent of teacher knowledge about the communities in which they teach.[1] The data of this study indicate that the majority of Negro science teachers who responded are graduates of a Negro college. These teachers teach in areas of subject-matter for which they were not prepared in college. This was especially true of science teachers who taught, in a majority of instances, without either a major or minor in science.

The evidence supported the conclusion that there was not enough guidance of prospective teachers into the elementary field of specialization, and there was a disproportionate preparation in the physical sciences, especially chemistry, when the teaching needs lay in the biological sciences. Too many science majors reported a major in chemistry, but are now teaching biology. Significantly, biology was taught in all of the schools studied, while chemistry was taught in less than 35 per cent of the schools.

In each one of the sections of the questionnaire about specific aspects of the community, the respondents indicated that *college sources were of least value in providing them with knowledge of the community*. Regardless of how the data were considered, these respondents cannot be

* Conference on the Education of Teachers in Science, Teachers College, Columbia University, November 14, 1947.

[1] Edward K. Weaver, *Meeting the Needs of Negro Science Teachers in Alabama*, unpublished Ed.D. project, Teachers College, Columbia University, 1947.

said to have had adequate preparation for participation in a school-community program to utilize resources in solving the problems of everyday living.

The teachers used conversations and community surveys in securing knowledge of the community which they possessed. This indicates necessity of providing prospective and inservice teachers with adequate tools for collecting information about the community.

The urgency of the Negro people is to progressively solve their problems of full integration into the life of the community. Without development of techniques and competency for integrating the Negro people into the life of the community, a school-community program of education, in-so-far as these inadequately equipped teachers are concerned, is ineffective and sterile in direct proportion to the teachers involved.

The task of the teacher-education institution is to prepare teachers who will work in school community programs in such a manner that the schools in which they teach will become the focus of community effort toward progress, serving as a center for community activities, utilizing community resources in improving the educative services of the school. Teachers should not only attempt to serve persons of school age, but all ages and groups in the community, in the evening as well as during the day, through the school's workshop, gymnasium, assembly hall, and other facilities which should be open for use of the people in the community. At present, however, teachers in the schools for Negroes do not receive educational or professional preparation which would enable them to perform this service, they do not know enough about their communities to render the service, nor possess competency and technique to perform their role and function—their college courses have been of least value in preparing them for utilizing community resources.

Only through the fullest use of the theory and practice of democracy can teachers in a democratic society be successful in their efforts to integrate a segregated people into all aspects of life. What is needed is an educational program through which colleges will seek to develop within teachers democratic attitudes, opinions, and patterns of belief and conduct. This means an educational program specifically oriented toward the democratic theory and practice. It means an educational preparation designed to enable teachers to develop value judgments as to whether the present position of the Negro people, and other minorities, is good or bad for the preservation and extension of democracy into the lives of all the people.

Such professional education must be based on a conscious and deliberate plan to develop democratic attitudes, opinions, and patterns of belief and conduct *which do not now exist*, but which are suitable and useful in integrating the Negro people into American life. It demands careful consideration and study of socially significant and controversial issues which are of concern to the Negro people. It means provision of opportunities for teachers to gain competency which will enable them to work to remove aspects of everyday living which confuse Negroes and whites and cause them to oppose one another. It means providing opportunities for teachers to work toward elimination of all social problems which are of disadvantage to the Negro people, to the disadvantage of all of the American people, through provision of educational and professional experiences within the areas wherein the major social problems lie. Teachers must be developed who will, on the basis of the preparation, bring to bear on all problems the social, human, and natural resources of the community in solution of socially significant, controversial, meaningful, and pertinent problems of community living.

OPINIONS OF NEGRO SCIENCE TEACHERS ON SOME SOCIALLY SIGNIFICANT ISSUES

A survey of teacher opinion on some socially significant and controversial issues was made. This survey was based on R. Will Burnett's opinionnaire, *The Opinions of Science Teachers on Some Socially Significant Issues,* a study made for the Subcommittee on Teacher Education of the National Committee on Science Teaching under the direction of Dr. S. R. Powers, and published at Teachers College in 1939.

A large majority of the Negro teachers of science conceived as their function the task of facing, with young people, the problems, needs, and interests of youth and society, and in bringing to bear their specialized knowledge and ability in the progressive solution of the problems. The teachers conceive as their role the increasing satisfaction of the needs, interests, and problems of young people, and the resolution of tensions which are theirs.

In spite of this professed belief, the college teachers, college science majors, and teachers inservice who responded are avoiding, for the most part, the controversial and socially significant issues which represent areas in which young people must, or are extremely likely to encounter problems. Of the sixteen controversial and socially significant issues examined, the ones most commonly avoided were: man's place in evolution; consumer education; relative merits of the various healing arts; sex education; questions of morals and ethics; venereal diseases; conflicts in views of the universe and man's place therein; conflicts between science and traditional religious beliefs; and political questions involving public health and conservation of natural resources. These issues are, for the most part, different from issues avoided by Burnett's respondents, who were, in the vast majority, all white science teachers. Further, these issues are of greatest importance in solving the Negro problem. Teachers state that reasons for avoiding these issues are: (1) lack of pupil maturity; (2) disapproval of parents; and (3) insufficient personal knowledge.

Teachers expessed opinions on the following controversial issues: relative weights of the two causative factors, environment and heredity, in producing racial and socio-economic differences; immutability of human nature in regard to the development and maintenance of institutions and ways of life; evolution and man's place therein; control of scientific research for Man's welfare; universality of goods and bads; fatalistic determinism, supernaturalism, and relation between traditional religious beliefs and science. A characteristic of responses from college teachers, college science majors, and high school teachers to both the general and specific questions on each item was *inconsistency, contradiction, and confusion on each item and failure to apply scientific, materialistic, or pragmatic attitudes, habits of thinking or reasoning to the responses.* No pattern of response other than inconsistency and contradiction could be predicted in any instance.

The teachers were aware of inadequacy in their professional preparation and consider present science education curriculum offerings as designed for preparation of doctors, engineers, and research specialists and as of little functional value to teachers. They suggest areas of specialization be set up to include more attention to study of and research upon; growth and development of human beings; sexual adjustment and marital hygiene; food requirements and metabolic changes; mental health and hygiene; coherent world view and ability to adjust conflicts in thinking which arise from scientific interpretation of the nature of the world, man, and society; propaganda analysis; conservation of human, social, and natural resources; solving and dealing with practical problems of consumer education, transportation, communication, consumer action, and governmental control of the productive process; impact of science

on society; implications of science for development of modern industrial power age; principles of ethics consistent with the findings of science and workable in modern technological society; research conditions and methods which must be fulfilled before generalizations may be made; controversial issues such as political questions of labor and government, control of resources, socialized medicine; and more attention to the nature of man, his behavior, and his various cultures.

Teachers were concerned with present inadequacies which stem from failure of colleges preparing teachers to provide opportunities for prospective teachers to spend enough time in studying needs, interests, and problems of children, their varying backgrounds and abilities, and in developing competency to deal with children who differ in their needs, interests, problems, abilities, and backgrounds.

There was grave concern expressed over the need to spend more time on evaluation and development of competency of evaluating more than information and subject-matter. Teachers wished to observe application of educational theories in concrete situations while still in college; they wished to evaluate for generalizations, understandings, principles, laws, concepts, attitudes, skills, and competency in utilizing information and knowledge in application to everyday problems. Teachers state a concern over the fact that there is too little agreement in point of view and approach to education as presented in the various subject-matter courses in science and the professional education courses offered in the teacher training courses. There is an urgent desire for agreement on educational programs based on school-community activities, and the desire to use community resources in such activity.

Teachers express concern and desire for the teacher education institutions to assume their role and function of providing inservice and preservice teachers with competency to deal with socially significant and controversial issues which are vital and of concern in community living.

The data of this study indicates that Negro teachers differ markedly in their opinions and professional preparation with white teachers. Statistically significant differences between the opinions and professional preparation of teachers of science in schools for Negroes and schools for whites were apparent on every general question and in many specific instances. Cultural factors, segregation and discrimination, inferior facilities, and isolation from both professional and educational participation may almost be totally accredited for this difference.

The results of this study indicate that the culture and the educational preparation of teachers for Negro schools operates in such manner as to force onto such teachers a contradictory and inconsistent approach to the basic problems of living in a democratic society. This contradictory and inconsistent approach to everyday living is reflected in the failure of the Negro colleges to face the problems of providing Negro teachers with competency to use community resources to solve the problems of the Negro people. It is reflected in the confused and contradictory opinions, beliefs, attitudes, and techniques which Negro teachers utilize to cope with the vital problems which face young people. Youth will deal with problems of sex relations, venereal diseases, moral codes and ethics, conflicts with religion and science, and other such problems when they are provided adequate significant evidences on which to make value judgments. Obviously, youth make more mature judgments and wiser decisions when they have scientific and valid bases for the making of such decisions.

It is possible to conclude, then, that teacher colleges preparing Negro teachers do not adequately provide teachers with techniques for the full integration of the Negro people into the life of American communities. Preservice and inservice

teachers are developing opinions which are not only inconsistent and contradictory, but which actually increase their incompetence and ineffectiveness in dealing with the problems which are of most concern to the Negro people. The result is an educational and professional preparation of Negro teachers which is devoid of sufficient opportunities for these teachers to consciously plan and have experiences designed to develop opinions, beliefs, patterns of conduct, attitudes, techniques, and competency in terms of the socially significant and controversial aspects of everyday living as a Negro in the United States. Further, these controversial issue lie in areas of science education, and are of most concern to the solution of the problems of the Negro. They are, likewise, problems whose solution would solve many important issues of American democracy.

THE USE OF COMMUNITY RESOURCES IN THE EDUCATION OF NEGRO TEACHERS

In order to document use of community resources in the education of Negro teachers it is possible to discuss the form and content of two courses which seriously attempt to correct the weaknesses previously outlined. The courses under consideration are *Bio-Social Development of the Individual* and *Science for the Elementary School Teacher* offered at the State Teachers College at Montgomery, Alabama.

The form and organization of both these courses stems from the following consideration of the learning process. We learn almost 75 per cent of what we know through the sense of sight; about 13 per cent through the sense of hearing; and the remaining 12 per cent through other senses, such as taste, and smell. Our mental and muscular activity occurs in response to stimuli, and we recognize these stimuli through one or more of the sensory facilities. Objects, lights, motions, sounds, and the like stimulate the senses. Opportunities for the largest possible combinations of the sensory experiences demand observation, reading, writing, listening, speaking, thinking, and the like. Plentiful use of movies, flat pictures, field trips, experiments, recordings and the like increase possible sensory experiences. We may say, then, that *we learn through the stimulation of our senses, and the more sensory experiences which are combined the more apt learning is to take place.*

One important difference between man and other animals lies in his ability to generalize. This ability demands reflective thinking, based on the recall of previous experiences and use of these experiences in solving present problems, satisfying present needs, and serving present interests. Individuals have to learn to think in this manner, and the best way to learn to think reflectively is to practice reflective thinking; the best way to learn how to generalize is to practice forming generalizations; the best way to learn how to solve problems is to practice solving problems; the best way to learn to satisfy needs and serve interests is to practice satisfying needs and serving interests. Students must be provided opportunities to solve problems, satisfy needs, serve interests, generalize, formulate understandings, develop skills and habits, through actually observing, discriminating, recognizing, objects, symbols, principles, and concepts in numerous meaningful and significant learning situations. We learn and remember longest those things which are associated with strong stimuli, which stimulate the greatest number of our senses, which occur and re-occur frequently, and which, to us, are important. We learn and remember those things which we desire to learn, and which, to us, have meaning. *We learn best when the learning situation is designed to enable us to solve our problems, satisfy our needs, serve our interests, and when such learning experiences are significant and pertinent to us in our everyday lives, or when they have a present sifnificance and meaning for the future.*

No real learning occurs without interest. Interest is the sense of value which is felt

for the material being learned. Interest involves the individual in gathering new ideas, facts, skills, generalizations, insights, understandings, concepts, laws, principles and the like. Acquisition of these new ideas, facts, and the like is conditioned by individual differences in education, personality, experience, and character. Self-activity is necessary for learning to take place. There is no actual learning without effort, reaction, and retention by the learner. Activity includes whatever is utilized by the individual in reaching his goal. Many activities have as their purpose formation and development of skills and techniques. Skills are well established ways of doing things. Habits are tendencies to respond in a definite manner, created in whole or part, by experience, or performance. Skills and habits are often acquired when the learner is told in advance what skill or habit is to be acquired, when a keen desire to develop this skill is aroused, when the learner is inspired with confidence in his ability to acquire the skill, when the sequence of learning experiences is arranged from the simple to the complex, and when explanations are so clear, step-by-step, of how the skill is to be acquired, that the learner knows precisely what he is to do, how he is to do it, why he is to do it, and the results expected of him throughout every step of the learning process. *The learner should be fully aware of what he is going to do, how he is going to do it, why he is going to do it, and other results expected of him before embarking on the learning process.*

On the basis of these formulations the two courses are conducted on a learning by doing basis. About 75 per cent of the student's time is spent in performing activities. Practical everyday life experiences are used wherever possible, and are preferred to other types of activities. Wherever real life situations cannot be utilized, the attempt is to simulate real life situations as closely as possible. Activities take the place of lectures and other formal class experiences—there is a minimum of lecturing. The staff is in relation to students of consultants lending specific aid where difficulties occur.

Activities are grouped around central topics, problems, principles, or concepts. The activities involve the following kinds of experiences: "doing about," "reading about," "listening about," "writing about," "speaking about," and "thinking about" activities. Each student is expected to perform or do, read, listen, write, speak, and think about each activity. Students work on activities individually and in groups, and perform activities related to the central topics or problems.

Activities are further divided into "Must Do" and "Optional" groups. All activities labeled "Must Do" constitute the minimum requirement and provide common experiences. Optional activities provide for additional and supplementary work. If neither the "Must Do" or "Optional" activities serve the needs, interests, or problems of the students they are at liberty to make up their own activities, the only stipulation being that the "made-up" activity lie within the general framework of broad coverage of the course.

In handling their obligations students must accept responsibility for: (1) becoming clear on what to do, how to do it, why it is being done, and results expected *before* working on the activity; (2) making out contracts estimating the time-duration of the activity, activities selected, materials and resources to be used, conferences and the like to be held, and the order of performance of activities; (3) becoming a member of a group working on similar activities; (4) performing activities; (5) deriving laws, principles, understandings, concepts, generalizations, and the like during the course of the units work; (6) developing skills and competency in applying what has been learned to everyday situations; and (7) criticism and discussion of the work.

The course Bio-Social Development of the Individual is an integrated-core course

in the general education program at this college. It is given to all Freshmen and "new" students at the college—hence most students at the college take the course at one time or another. The course has four units. Examination of the contents of the course indicates implications for using community resources. Since the college under consideration is a Teachers College, presumably these students, or the majority, will become teachers. *Bio-Social integrates biology, sociology, psychology, and health.*

Unit One: What Bio-Social Is About includes activities designed to enable students to define and experience integration through reading, writing, speaking, listening, performing, and thinking about biological, sociological, psychological, and health materials. Students go to the library and define terms, check to see if their terms "make sense," try and state these definitions in their own words, write short papers describing integrative experiences they have had, list experiences common to living and non-living organisms or things, common characteristics of plants and animals, human beings, ascertain differences and similarities between plants and animals, between plant and animal societies or communities, and similarities and differences between human and animal behavior. Finally, after some three weeks of experience for two hours daily, students work out activities in terms of the relation of the individual to the environment, and especially in terms of the relations between the soil, water, and air and the problems of cotton and tenancy, of poverty, of Negro-white relations in Alabama as affects illiteracy, segregation and discrimination and the lives of Negroes.

Unit Two: How the Individual Maintains Himself involves students in activities on the changes which take place in food as it passes through the alimentary canal; the digestive action of the enzymes; analysis of saliva for acidity or alkalinity; selection of toothpaste to overcome acidity; causes of cavities in teeth; effect of diet on bone structure; demonstration of osmosis; analysis of temperature changes; study of various tissues; study of protoplasm; study of beef and sheep heart; structure of blood; analysis of blood types; discovery of "what is bad blood"; injection of foreign substances into lymphatic system, and function of white blood cells; explanation of venous valves; explanation of effect of frequent shampooing on hair; explanation of changes taking place during adolescence; analysis of dietary needs of several students; finding answers to questions about digestibility of certain foods; reducing, estimation of health status, basal metabolism, blood transfusions, freaks, glandular and nervous reactions, annual cost of medical treatments in United States, patent medicines, effects of hormones, explanation of blood pressures, causes of pimples, baldheadness, and the like.

Unit Three: How the Individual Perpetuates Himself. Activities involve the universality of the reproductive process, including: field trips, experiments in molds, shoots, flowers, germination, regeneration in Planaria, and the like. Activities on embryonic development, especially chick development; activities on structure of male and female reproductive systems, including study of models and charts of human reproductive system, sexual and asexual reproductive structures in plants and animals such as spirogyra, ferns, various seeds, dissection and study of pregnant mice and guinea pigs; activities on appearance of hereditary traits in succeeding generations, including breeding of Drosophila melanogaster and guinea pigs and mice; psychological and sociological activities including comparative study of social behavior of males and females, man and woman's place in society, their major contributions, petting, development of dancing, calculations of potentialities of reproduction, checks on unlimited reproduction, courtship, marriage and community regulations, premarital and extramarital sexual relations, development of moral standards,

examination of marital customs, statistical analyses of marriage, death, divorce rates, analysis of factors involved in miscarriages and abortions, degrees of kinship in marital partners, regulations regulating sexual relations, home and family life, changes in family brought on by impact of science on society, reports on Mathus and inadequacies of his theories.

Unit Four: How the Individual Develops Behavior and Personality. Activities include a community survey covering the community's local history, physical factors, present population, industries and businesses, transportation, communication, local government, social and welfare agencies, housing facilities, religious preferences, health facilities, recreational facilities, library facilities, and educational level of the people; analysis of how the individual's behavior is determined by the social field of which he is a part; the effect of membership in the nation, religious group, class, minor group, family, on behavior; analysis of how personality develops, including the Freudian concept or theory of personality development, the effect of drives and emotions on behavior; activities on the effect of "being born a Negro" on personality development including problems arising from restriction of economic and occupational opportunity, limitations in educational opportunity, exclusion from civic and cultural benefits, restrictions on social mobility, and stigmas of inferiority attached to the Negro people; activities on the effect of the mind (mental activity) on the body; differences in ages and backgrounds; characteristics which are inherited; analysis of factors in present or past which play or probably played a significant part in determining behavior including home, economic level, cultural level, family solidarity, parents, siblings, medical history, community backgrounds, and present adjustments or maladjustments; ratings for persistence and other personality factors; personality and vocational testing and analysis; analysis of personal psychograph, activities on behavior during stress and strain, conflict and thwarting, escape through flight, influence of attitudes, how failure influences behavior, forms of rationalization, day-dreaming as an escape technique, compensation, inferiority feelings, psychological posing, reducing strain through ego-inflation, self-suggestion; influence of movies, home, press, radio on behavior; activities on the learning process, memory; activities on what it means to be born a Negro, the Negro people and the land, migration to the city, Negro classes, race, what can be done about it, problems of the Negro people and the unity of Negroes and whites, traditions of Negro culture, significance of resistance to change and solution of Negro problem, patterns of inner revolt and outward submission, patterns of inward and outward revolt of individuals, patterns of planned struggle through organized mass organizations.

The course *Science for the Elementary School Teacher* is divided into two parts. The first part is concerned with development of the theory of education necessary for a course in elementary science on the elementary school level in terms of the core curriculum of Alabama. Discussions involve the theory of the elementary school and the place of science in such program, with emphasis on the social role of science. In line with the approach students work out a project during the first phase of the course. The second phase of the course is spent in performing experiments and activities, in developing techniques for teaching.

The assignment for this course indicates something of the course content. The assignment and performance proceeds, as follows:

1. Students write descriptive statements about the community they expect to work in, or the local community. This year the entire class is working on the local community in conjunction with the inservice

program with the county teachers wherein the college is located.

2. Students next write a descriptive statement about the school—this year using nine of the schools in the local county for their information and facts.

3. Students then write descriptive statements about the children in the schools.

4. They next analyze the three sets of descriptive statements and interpret them as to whether they reveal needs, interests, problems peculiar to the community, school, and children who will be involved in the educative process.

5. On the basis of this analysis, students identify and isolate those elements which may be stated as objectives of teaching—these objectives are stated as needs, interests, and problems and in such manner as to demand activity for their attainment.

6. Students then prepare units of instruction in elementary science designed to contribute to the objectives enumerated. Such units of instruction include activities designed to contribute to attainment of the objectives.

7. Students then prepare a list, derived from the activities, of materials of instruction which includes films, posters, texts, pamphlets, diagrams, charts, graphs, and the like, which they anticipate using during the course of teaching these units. These lists are "practical" to the extent that they consist of materials which are available in Alabama communities, or which may easily be produced. Where materials must be purchased, lists are prepared for this purpose. The materials of instruction also include evaluative devices which will be used.

8. During the second phase of the year's work, students perform the activities, correct and improve their techniques, develop skills, and improve their use of community resources by perfecting activities in light of additional experiences which they have.

INVESTIGATION OF STUDENT OPINION CONCERNING SURVEY COURSES IN SCIENCE *

W. W. E. BLANCHET

Fort Valley State College, Fort Valley, Georgia

STATEMENT OF THE PROBLEM

THE purpose of this investigation was to determine the opinions of students concerning the relative values of topics which they had studied in survey courses in the natural sciences.

TECHNIQUE EMPLOYED

This investigation was undertaken on the assumption that the opinion of students concerning the values of the various topics that they studied in science survey courses would provide one basis for selecting the materials of such courses.

Two lists of topics were used in this investigation, one consisting of topics related to the biological sciences and the other, of topics related to the physical sciences. The topical items that constituted these two lists were obtained from two composite outlines. These two outlines consisted of topics related respectively to the physical sciences and the biological sciences. The topics used in formulating these outlines were the chapter, center, and paragraph headings of textbooks that were designed for survey courses in science. Ten textbooks furnished the topics for the composite outline in the physical sciences, and seven textbooks provided the topics for the outline in the biological sciences.

The outlines were formulated in each case by beginning with a basic outline and adding at appropriate places in it the topics that were contained in each textbook.

Each of the composite outlines was submitted to three specialists in the teaching of science. These specialists examined the

* This article is based on one unit of the author's dissertation for the Ph.D. degree at the University of Michigan (*A Basis for the Selection of Course Content for Survey Courses in the Natural Sciences*).

outlines critically to insure, first, that the position of each topic in the outline was defensible, and secondly, that no topic appeared more than once in the outline unless the respective differences in its connotations at the two or more points clearly demanded that it be considered as two or more separate topics.

Since the complete outlines were too voluminous [2,121 physical topics and 1,589 biological topics] to have students rate each topic, it became necessary to devise a basis for securing a selected sampling of the topics. It was arbitrarily decided, therefore, to select only those which were designated as of primary or secondary importance. It will be remembered that three specialists in the teaching of science had examined each outline to approve the defensibility of the position of each topic in the outline.

Closely related topics were listed together under one heading and items were deleted from one part of the list if they were included in topical items appearing elsewhere in it. For example, "The Earth" was deleted from the topics listed under the Physical Sciences because its discussion would certainly be included in those of several items which were listed under Geology.

As a result of the procedure just described, two composite lists of topics were compiled containing respectively, 42 topics related to the biological sciences and 234 topics related to the physical sciences. The difference in the number of topics that were contained in the two lists was due to the procedure followed in formulating the two composite outlines which furnished the topics respectively for each list. The outline of a single textbook was used as a basis for the composite outline of topics related to the biological sciences. The topics in that book were inclusively worded and uniformly distributed among its major divisions. In contrast, the outline for each major division of the composite outline of topics related to the physical sciences was taken from the textbook which presented the greatest number of topics dealing with that division.

The 234 physical topics and the 42 biological topics were organized, respectively, into two rating sheets.

A group of 37 sophomores and 13 juniors of The Fort Valley State College, Fort Valley, Georgia, consented to rate each topic contained in the two lists. All of the juniors had completed a one-year survey course, respectively, in the biological sciences and the physical sciences; the sophomores had completed a one-year course in a biological-science survey and two-thirds of a one-year course in a physical-science survey. A copy of each of the two lists of topics, along with the following letter of instruction was sent to each student.

Dear Student:

I am submitting to you a list of statements related to the physical sciences and the biological sciences.

You are asked to read each statement very carefully and to decide upon its relative importance as one to be included in survey courses in science. Such courses are designed as part of the general education of all college students.

The following three-point rating scale is provided for your convenience in rating the various topics:

3—Statement is of prime importance and should be included in a science survey course.
2—Statement is of some importance and should be included in such a course if time permits.
1—Statement is relatively unimportant and should not be included in such a course.

For example, if you feel that the statement "Life is always found associated with organized protoplasm" is of prime importance and should be included in a science survey course, place a check opposite it in the column headed (3). If "The food supply of living organisms is provided by green plants" seems to you to be relatively unimportant, and hence should not be included in such a course, then place a check opposite it in the (1) column. Place a check opposite "The interdependence of life" in column (2) if you consider the topic of some but not of essential importance.

Illustration:

	3	2	1
Life is always found associated with organized protoplasm	√		
The food supply of living organisms is provided by green plants			√
The interdependence of life.....		√	

Thanking you for your cooperation, I am

Very truly yours,

W. W. E. Blanchet.

When all of the lists had been returned and the ratings given to each topic had been tabulated, the mean of the ratings given by the 50 students to each topic was calculated. For example, "Science may be made to aid the body in its fight against pathogenic agents" was given a rating of 3 by 35 of the students, a rating of 2 by 9, and a rating of 1 by 6. The mean of the ratings given to this topic was calculated to be 2.58. The mean of these ratings given by the 50 students was assumed to be the rating of that topic.

The topics were then ranked in descending order of their mean ratings. Three distributions were thus prepared: one of the 42 topics of biological science; one of the 234 topics of physical science; and a third of the complete list of 276 topics of biological and physical science.

Table I shows (1) the mean rating of each of the 276 topics, (2) the rank of each topic relative to the complete list of 276 topics, (3) the rank of each biological topic relative to the 42 topics which were contained in one of the lists, and (4) the rank of each physical topic relative to the 234 topics contained in the other list.

TABLE I*

THE MEANS AND RANKS COMPUTED FOR EACH TOPIC FROM THE RATINGS GIVEN BY THE FIFTY STUDENTS

Topics	Mean	Rank		
		I	II	III
What is sound	2.96	1		1
Disease and its treatment	2.93	2.5	1	
The transformation of heat into other forms of energy	2.93	2.5		2
What is light	2.92	4		3
What is disease	2.89	5	2	
Geology defined	2.87	6		4
Life is always found associated with organized protoplasm	2.86	8.5	3.5	
Venereal disease	2.86	8.5	3.5	
Names of chemical elements	2.86	8.5		5.5
The relation of matter and energy	2.86	8.5		5.5
Sources of energy	2.85	11		7
Heredity is a potent factor in human life	2.84	13.5	5	
The difference between heat and temperature	2.84	13.5		9
Work and energy	2.84	13.5		9
The seasons	2.84	13.5		9
The ear and its responses to sound	2.83	16		11
Production and speed of sound	2.82	19		12
The important types of energy	2.82	19		14
Motions of the earth	2.82	19		14
Eclipses of the moon and the sun	2.82	19		14
Effects of the moon upon the earth	2.82	19		14
The human eye, its defects and corrections	2.80	25		20
The nature of chemical and physical changes	2.80	25		20
Acids, bases, and salts when in water solutions will conduct an electric current	2.80	25		20
Matter exists in three physical states	2.80	25		20
Conservation of energy	2.80	25		20
Transformation of energy	2.80	25		20
The great universe	2.80	25		20
The discovery and application of scientific facts regarding food have contributed much to man's welfare	2.79	30.5	6	

* Table I is read thus: As a result of the procedure described "What is sound" had a mean rating of 2.96, a rank of 1 within the complete list of 276 topics (Column I), and a rank of 1 within the list of 234 physical topics (Column III). "Disease and its treatment" had a mean rating of 2.93, a rank of 2.5 (Column I), and 1 (Column II), respectively, among the complete list of 276 topics, and the 42 biological topics, etc.

Topics	Mean	Rank I	Rank II	Rank III
Production of electric charges	2.79	30.5		25
Forces exerted between electric charges	2.79	30.5		25
Oxidation and reduction	2.79	30.5		25
Can contagious diseases be eliminated	2.78	35	7	
Transformation of one element into another	2.78	35		28.5
Methods of measuring temperature: thermometers, etc.	2.78	35		28.5
Laws governing the motion of bodies	2.78	35		28.5
Energy is usually measured in the form of heat	2.78	35		28.5
Checking the spread of disease	2.77	38.5	8	
What happens when a metal is magnetized	2.77	38.5		31
Some triumphs of disease prevention	2.76	44	9.5	
Functional diseases	2.76	44	9.5	
Characteristics of sound	2.76	44		35
The transmission of light through space	2.76	44		35
Types of organic compounds such as alcohols, ethers, etc.	2.76	44		35
Characteristics of gases	2.76	44		35
The conversion of matter into energy of radiation	2.76	44		35
The force that keeps the moon from falling into the sun	2.76	44		35
Climate	2.76	44		35
The respiratory diseases	2.74	50	11	
Why some substances react much more quickly than others	2.74	50		39.5
There are two states of energy	2.74	50		39.5
Mental illness and mental health	2.73	54	12	
Electrical illumination is the chief application of artificial light	2.73	54		42.5
The behavior of electric charges	2.73	54		42.5
The structure of organic compounds and its effect on chemical changes involving them	2.73	54		42.5
The scope of astronomy	2.73	54		42.5
Atoms differ in their capacities to combine with one another	2.72	59.5		47.5
Molecular theory of liquids and solids	2.72	59.5		47.5
Description of matter	2.72	59.5		47.5
The meaning of power	2.72	59.5		47.5
What is force	2.72	59.5		47.5
Volcanoes	2.72	59.5		47.5
Various ways of producing electric currents	2.71	64.5		52.5
Chemistry has provided many weapons for the control of disease	2.71	64.5		52.5
Solutions	2.71	64.5		52.5
Measurement of heat	2.71	64.5		52.5
Vitamins are important food constituents	2.70	69	13.5	
Many characteristics of plants and animals are transmitted to their offspring	2.70	69	13.5	
What is color	2.70	69		56
The effect of two or more forces acting simultaneously on a body	2.70	69		56
Pressure	2.70	69		56
Sound recording	2.69	74.5		60.5
Factors affecting the speed of chemical changes	2.69	74.5		60.5
Conversion of heat into the power for driving engines	2.69	74.5		60.5
Vaporization and condensation	2.69	74.5		60.5
The principal processes for producing heat	2.69	74.5		60.5
Sources of the sun's heat	2.69	74.5		60.5
Ultra-violet light and its uses	2.68	82		68
Color vision	2.68	82		68
The speed of light	2.68	82		68
Generation, transmission, and distribution of electricity	2.68	82		68
The classification of chemical reactions	2.68	82		68
Kinetic-molecular theory of matter	2.68	82		68
The calendar	2.68	82		68
Growth of the science of astronomy	2.68	82		68
The interior of the earth	2.68	82		68
The electric field surrounding an electric current	2.67	87		73
All living things reproduce their own kind	2.66	92	15	
Effects of light from a moving light source	2.66	92		77.5
Nature of electric charges	2.66	92		77.5
Combustion-oxidation	2.66	92		77.5

Topics	Mean	Rank I	Rank II	Rank III
Weights of atoms and molecules	2.66	92		77.5
Methods of transferring heat	2.66	92		77.5
Standard time	2.66	92		77.5
Earthquakes	2.66	92		77.5
Types of rocks and their products	2.66	92		77.5
All chemical changes are accompanied by energy changes	2.65	98		83
Changes from the solid state to the gaseous state and the reverse process	2.65	98		83
Effects of the atmosphere on the earth	2.65	98		83
Theories and structure of the atom	2.64	101.5		86.5
Fuels and their heat value	2.64	101.5		86.5
All bodies fall with the same speed	2.64	101.5		86.5
Shape of the earth	2.64	101.5		86.5
Characteristics of color	2.63	105		90
Electrical communication: telephone, telegraph, radio, etc.	2.63	105		90
Magnetic effects produced by an electric current and their applications in modern life	2.63	105		90
The inert gases	2.62	109		94
Food and health	2.62	109		94
Melting and freezing (solidification)	2.62	109		94
Mass and weight should not be confused	2.62	109		94
Storms: cyclones, hurricanes, tornadies, thunderstorms, ice storms, etc.	2.62	109		94
Beats and pulsations of sound	2.61	115		100
Color due to scattering of light	2.61	115		100
The law of the electric circuit	2.61	115		100
The magnetic field surrounding a magnet	2.61	115		100
Chemical equations (the chemist's way of expressing chemical changes)	2.61	115		100
Chemical compounds are compounds of chemical elements	2.61	115		100
Origin of the sun	2.61	115		100
Sympathetic vibrations	2.60	123		108
Television	2.60	123		108
Electric currents produce magnetic, chemical, and heat effects	2.60	123		108
The electric eye and its application in modern life	2.60	123		108
How electric charges are stored	2.60	123		108
Carbon forms ring compounds like benzene, carbolic acid, etc.	2.60	123		108
Effects of the addition and subtraction of heat	2.60	123		108
Arrangement and motion of the planets	2.60	123		108
Minerals and their products	2.60	123		108
Different forms of precipitation such as rain, snow, sleet, frost, etc.	2.59	128		113
Science may be made to aid the body in its fights against pathogenic agents	2.58	132.5	16	
Lenses	2.58	132.5		117
Types of magnets	2.58	132.5		117
Isotopes: two or more forms of an element possessing similar properties, but differing in atomic weight	2.58	132.5		117
Radioactivity	2.58	132.5		117
Why is it harder to stop a heavy body than a lighter one when both are moving with the same speed	2.58	132.5		117
The earth as a clock	2.58	132.5		117
Apparent changes in the shape of the moon	2.58	132.5		117
The cycle of metabolism as carried on by living organisms makes the continuance of life on the earth possible	2.57	138	17	
How musical instruments produce sound	2.57	138		121.5
Theories to explain the existence of water on the earth	2.57	138		121.5
Sounds are classified as noise and tones	2.56	142		125
Man's knowledge of magnetism has slowly developed	2.56	142		125
Some chemical changes need to be activated while others do not	2.56	142		125
Stars and suns	2.56	142		125
Seismograph: an instrument for recording earthquakes	2.56	142		125
Lightning and Lightning rods	2.55	147		130
Water and its applications to daily life	2.55	147		130

Topics	Mean	Rank I	Rank II	Rank III
The typical reaction involving organic compounds	2.55	147		130
Electrical nature of matter	2.55	147		130
Time as determined by the sun	2.55	147		130
Pitch, loudness, and quality of sound	2.54	153		135
Use of electricity for heating purposes	2.54	153		135
Forces between magnetic poles	2.54	153		135
Sources of the atmosphere's heat	2.54	153		135
Physical measurements of the earth	2.54	153		135
Living organisms have the ability to prepare their food and to transport it throughout the body	2.53	156.5	18	
Maintaining a constant temperature for rooms and refrigerators	2.53	156.5		138
Living organisms utilize the food and dispose of the waste	2.52	159.5	19	
Factors involved in flying an airplane	2.52	159.5		138
Instruments used in reckoning time	2.52	159.5		138
Irregularity of the earth's surface features	2.52	159.5		138
Pathogenic organisms	2.51	165.5	20.5	
Cultivated plants and domesticated animals have been improved through breeding and selection	2.51	165.5	20.5	
Motion pictures	2.51	165.5		144.5
Motion in a curved path	2.51	165.5		144.5
Why objects fall	2.51	165.5		144.5
The history of the earth is divided into eras, periods and epochs	2.51	165.5		144.5
Forms of water: oceans, rivers, lakes, ground water, etc.	2.51	165.5		144.5
Unequal hardness of layers of rock contribute characteristic features to the landscape	2.51	165.5		144.5
Fluorescent and phosphorescent light	2.50	171.5		150.5
The simple magnifying glass	2.50	171.5		150.5
Large scale chemical warfare is employed in combating insects	2.50	171.5		150.5
Insulators or non-conductors of heat and their uses	2.50	171.5		150.5
The relative amount of moisture in the atmosphere and its effects	2.50	171.5		150.5
Instruments which supplement the telescope in exploring the universe	2.50	171.5		150.5
Behavior and mental activity	2.49	180	23.5	
The theory of evolution	2.49	180	23.5	
Certain features of Darwin's explanation of the evolutionary process have been modified	2.49	180	23.5	
Man is believed to represent the crowning achievement of the evolutionary process	2.49	180	23.5	
The earth is a giant magnet	2.49	180		157
The properties of elements depend upon their structure	2.49	180		157
Periodic classification of the elements	2.49	180		157
Telescopes	2.49	180		157
Motions of the stars	2.49	180		157
Weather and weather forecasting	2.49	180		157
Extensiveness of the water on the earth	2.49	180		157
The apparent change in the pitch of sound from moving objects	2.48	188		163
Advantages of simple machines	2.48	188		163
Origin of planets	2.48	188		163
The sun as a giant sphere of hot gas	2.48	188		163
Mountain building	2.48	188		163
Photosynthesis stores energy for living organisms	2.47	192.5		167.5
Latitude and longitude	2.47	192.5		167.5
Shooting stars	2.47	192.5		167.5
Comets	2.47	192.5		167.5
Poisons and their action	2.46	198	26	
Color films	2.46	198		172.5
Cleansing	2.46	198		172.5
Synthesis of organic compounds such as plastics, synthetic flavors, etc.	2.46	198		172.5
The equivalence of heat and work	2.46	198		172.5
Areas affected by changes in the earth's crust	2.46	198		172.5
Erosion and transportation	2.46	198		172.5

Topics	Mean	Rank I	Rank II	Rank III
Slanting layers of rock make it possible to read the history of the geological events long past which have been written in stone	2.44	202		176
The principle of change seems to be a fundamental law of the universe	2.43	204	27	
Complementary colors	2.43	204		177.5
Waves and wave motion	2.43	204		177.5
Effects of sounding boards on the intensity of sound	2.42	209		182
Reflection of light and mirrors	2.42	209		182
Comparative weights of different substances	2.42	209		182
Physical measurements of the sun	2.42	209		182
The moon's atmosphere	2.42	209		182
Air conditioning	2.42	209		182
How the past history of the earth is recorded	2.42	209		182
Simple machines	2.41	214.5		187.5
The different parts of the sun	2.41	214.5		187.5
Water is capable of existing in the atmosphere in amounts depending on the temperature	2.41	214.5		187.5
Knowledge of the earth's history is quite recent	2.41	214.5		187.5
The autonomic-endocrine system plays the dual role of physiological control and emotional inception	2.40	220	28	
Effects of the construction of buildings and auditoriums on sound	2.40	220		192.5
The non-metals	2.40	220		192.5
Electric wave spectrum	2.40	220		192.5
The science of conducting an aircraft from a point of departure to the destination	2.40	220		192.5
Nature and composition of the atmosphere	2.40	220		192.5
Changes in rocks and minerals from exposure to the air	2.40	220		192.5
The apparent change in the pitch of sound from moving objects	2.39	225.5		197.5
The camera	2.39	225.5		197.5
Methods of measuring the distances to the stars	2.39	225.5		197.5
Movements of the earth's crust appear to be in progress all the time	2.39	225.5		197.5
The evolution of the plant body	2.38	229	29	
The location of stars	2.38	229		200.5
Surface features of the sun	2.38	229		200.5
Living organisms make adaptive responses to their environment	2.37	233	30.5	
The evolution of the invertebrates	2.37	233	30.5	
Ice manufacturing plants	2.37	233		203
Time as determined by the stars	2.37	233		203
Fossils	2.37	233		203
Origin of the moon	2.36	236.5		205.5
Location of dry regions with reference to well-watered mountain ranges	2.36	236.5		205.5
Descriptions of the planets	2.35	239		208
Petroleum and coal	2.35	239		208
Ores	2.35	239		208
Glare and shadows	2.34	242		211
An electric current is similar to a flow of water in a pipe	2.34	242		211
Surface features of the moon	2.34	242		211
The brightness of stars	2.33	244		213
Navigation	2.32	245		214
Metals and alloys	2.31	246.5		215.5
Reading the history of the earth from exposed rocks	2.31	246.5		215.5
The age of power has influenced man's social development	2.29	248.5	32	
Physical measurements of the atmosphere	2.29	248.5		217
The behavior of the individual	2.28	251	33.5	
The distribution of organisms is determined by their reaction to the environment	2.28	251	33.5	
The inclination of the earth produces seasonal effects that greatly modify weather	2.28	251		218
The division of the atmosphere to which weather is confined	2.27	253		219
Physical measurements of the moon	2.26	255		221
Rock layers are not uniform	2.26	255		221
Divisions of the atmosphere	2.26	255		221

Topics	Mean	Rank I	Rank II	Rank III
The interdependence of life	2.25	258.5	35	
Refrigeration	2.25	258.5		224
The constellations	2.25	258.5		224
Wind belts	2.25	258.5		224
The standard of life	2.24	261.5	36	
Taking pictures in the dark	2.24	261.5		226
The food supply of living organisms is provided by green plants	2.22	263.5	37.5	
Man's cultural development has come from very humble beginnings	2.22	263.5	37.5	
Distribution of mountains	2.21	265		227
Age of the earth	2.20	266		228
The scourge of pestilence	2.17	267	39	
The projecting lantern	2.13	268		229
Neon-type signs revolutionized electrical advertising	2.12	269		230
Physical measurements of the stars	2.11	270		231
The milky way	2.10	271		232
Maintenance systems in animals	2.08	272	40	
Man as the archdisturber of the balance in nature has created serious problems	2.06	273	41	
The social habits and institutions of today are deeply rooted in prehistoric time	2.04	274	42	
The monthly electric bill	1.88	275		233
Superstitions concerning the weather	1.52	276		234

FINDINGS OF TABLE I

Significant facts revealed by Table I are:

1. None of the 276 topics was rated either 3, as of prime importance or 1, as of relative unimportance, by all 50 students.
2. The range of the mean ratings of all 276 of the topics was 1.52–2.96, of the 42 biological topics 2.04–2.93, and of the 234 physical topics 1.52–2.96.
3. A total of 201 topics, or 72 per cent of the total number of 276 topics, received mean ratings between 2.46–2.96; all of the biological topics and 99 per cent of the physical topics secured mean ratings above 2.00. In other words nearly three-fourths of all of the topics of the combined lists were given almost equal ratings and the ratings which indicated that all were of practically essential value.

The facts revealed by the data of finding 3 would seem to indicate the general lack of careful discrimination on the part of the students between topics of importance and those of relative unimportance.

A similar lack of discrimination was revealed in a vocabulary study by Curtis [1] in which two lists of 629 terms of general science and 825 terms of biology were submitted to teachers in these respective fields. Each teacher was asked to indicate whether he considered each term as essential, desirable, or undesirable for inclusion in a list of terms which should be defined in a textbook of general science (or biology). More than half of the teachers evaluated more than 70 per cent of the terms in the lists for general science and biology as essential for inclusion in the glossaries of textbooks in these subjects, while only 3.02 per cent of the general-science terms and 1.45 per cent of the biology terms were judged undesirable by more than half of the teachers respectively of general science and biology.

Curtis [2] concludes that, "These facts and others revealed by the complete data would seem to indicate a tendency on the part of these teachers not to discriminate so closely between essential and nonessential scientific terms as textbook writers and classroom teachers might desire."

CONCLUSION

In so far as the results of this investigation may be valid, the following conclusion seems justified:

The lack of agreement by the students with respect to which topics were valuable for inclusion in survey courses in science (Findings of Table I) would seem to indi-

[1] Francis D. Curtis. *Investigations of Vocabulary in Textbooks of Science for Secondary Schools*, pp. 89–94. Boston: Ginn and Company, 1938.

[2] *Ibid.*, p. 93.

cate that such opinions are of little value in selecting course content. The wide diversity of opinion may have been due to

1. The inability of such students to discriminate between topics of importance and those of relative unimportance.

2. The lack of a thorough digestion of the materials included in the course resulting from the inclusion of too much material in it.

3. The lack of proper perspective of teachers with respect to the course, which would enable them to stress the more important topics in their teaching.

4. The remoteness of the course content from the activities and interests of the students.

The data of this study, however, give no indication of which, if any, of these four inferences is correct.

AUDIO-VISUAL AIDS IN COLLEGE SCIENCE

ROBERT A. BULLINGTON

MacMurray College, Jacksonville, Illinois

AUDIO-VISUAL materials have their place in any course in science, regardless of the educational level. Although this article deals specifically with experiences in a college survey course in science, all science teachers may find useful suggestions here.

The ideas presented have been developed as a result of experience with a two-semester orientation course in science for college freshmen. There is no laboratory work in this course. The use of audio-visual materials is especially desirable for this reason, and because there is a considerable condensation of subject matter and a need for time-saving procedures.

The various materials described below have been selected because it is believed that their use aids the learning process, they save time in presenting certain scientific concepts, and they provide simulated experiences to the students that can be gained in no other way. Also these materials provide variety that keeps interest at a high level.

Many types of teaching aids have their place in the science program. One or two kinds should not be used to the exclusion of others. In all cases the aids selected should be suitable to the grade level of the students. It is easy to bore young students with technical material or waste the time of college students with juvenile presentations.

In general, no type of aid should be used unless it deals specifically with subject matter that is a part of the course of study. For example, a film should not be shown merely because it happens to be available or because it is entertaining.

The use of *projected* audio-visual teaching aids will be emphasized here, but mention should be made of a number of other very helpful items. Maps, charts, models, and the globe are indispensable to the science teacher. Many have found that student-constructed charts and models are of value. The classroom demonstration in which various types of equipment are used is an invaluable part of a science course. Remembering the importance of all these, let us now turn our attention to the use of projection equipment in the classroom.

THE MICRO-PROJECTOR

Teachers of biological sciences will find a good micro-projector an invaluable aid in the laboratory, but this instrument is especially useful in the lecture course. By its use, one can quickly and clearly show the students the nature of such things as structure of cells and tissues, mitosis, bacteria, protozoa, yeast, mold, blood cells, and many other things.

The user of micro-projector should be familiar with his instrument before using it in the classroom. To save class time, he should discover by preliminary practice those things that may be satisfactorily projected.

SLIDES AND FILM-STRIPS

Although regarded by some as old-fashioned, the 3¼ by 4 lantern slide is still a very useful teaching tool. Home-made slides of certain kinds are easily prepared. Many schools have excellent collections of black and white and color slides. Others may be rented. The writer has had success in using slide sets in the general fields of astronomy, geology, and diseases.

The combination film-strip and 2 x 2 slide projector is a useful instrument for science teachers. An increasing amount of well-prepared material is becoming available for this machine.

THE OPAQUE PROJECTOR

The opaque projector is a versatile device for bringing a wealth of material to the classroom screen. By means of it, one can project clippings, pictures, charts, pages of books, etc. This instrument has recently been used effectively by the writer in presenting a composite outline of the development of atomic energy. Charts and pictures from several sources were gathered and projected in a logical sequence.

MOTION PICTURES

Motion pictures are used extensively in this college science course. It is felt that every science teacher who can secure a projector should draw upon the wealth of fine teaching films now available. There is scarcely a level of instruction or a phase of science for which a suitable picture cannot be found.

Certain general principles are followed in the use of movies. Too many pictures should not be selected. An average of one a week is sufficient. The author uses about fifteen reels per semester, each carefully selected to present a part of the subject matter in the course of study. Each is scheduled for a certain date and booked with the rental agency some months in advance.

As a general rule, not more than one film is shown in any one class period. There is an occasional exception made if two films form a sequence or develop related phases of the same subject. Short films of ten to fifteen minutes are preferred.

Class time is not wasted in setting up equipment. An effort is made to have everything in readiness at the beginning of a class period. Student operators have been trained in each class. These are students who plan to become teachers and who will benefit by the experience. This student assistance permits the teacher to spend more time in discussion before and after the showing.

This discussion is a very important part of every showing. The following is a general explanation of the procedure used. The instructor previews the material and is thoroughly familiar with its content. Before the showing he explains the purpose of the film and tells the students what to expect. After the showing, there is a discussion period. The content is reviewed and student questions are answered. If the students and the instructor feel that it is necessary, there is a second showing. During this showing, the students take notes on the film.

The information in some pictures is so concentrated that the students are unable to follow it and take notes. In such a case, the instructor prepares an outline and either puts it on the blackboard or gives each student a duplicated copy of it.

The student is made to feel that the material presented in motion pictures is a definite part of the course content. Examinations that are given include questions on all of the subject matter of the course, regardless of whether it was presented by text book, lecture, or through projection on the screen.

It must be emphasized that the use of projected audio-visual teaching materials is not a substitute for the teacher. Indeed the proper use of them requires considerable training and experience in definite teaching techniques.

The science teacher of today is most fortunate in having at his disposal such a wealth of teaching materials. It is up to him to use them wisely and well.

He has an obligation to his students to fulfill. It is his responsibility to use every means available in instructing his charges and to send them from his classes with a liking for and a full appreciation of the importance of science.

KOCH'S POSTULATES AS A SIMPLE LABORATORY EXERCISE IN BIOLOGY

J. ARTHUR HERRICK
Kent State University, Kent, Ohio

THE teaching of biology at all levels is often hampered because of the lack of simple, sure-fire, and inexpensive laboratory exercises. Biological experiments frequently refuse to conform to the regular class periods. Such problems are familiar to every experienced teacher from the high school to the graduate school.

One of our major objectives is to teach the so-called scientific method. The great German physician and bacteriologist, Robert Koch, has given us one of the most clear-cut step by step applications of the experimental scientific method ever devised. He formulated a simple and logical series of experimental procedures by which he proved the causal relationship of certain germs to specific diseases. His classic work still serves as a model for such research. To all modern biologists, this set of procedures and logic is known as "Koch's postulates". The application of Koch's postulates has contributed so much to the science of biology and medicine that they could well be a part of every course in general biology.

The object of this article is to briefly discuss the "postulates" and especially to show how they can be used in any classroom in a way that will be simple, sure-fire, inexpensive, and impressive.

The "postulates" are as follows:

1. The suspected organism must be observed in every case of the disease.
2. The organism must be isolated and grown in pure culture.
3. The organism, in pure culture, when re-inoculated into a susceptible host, must reproduce the disease.
4. The germ must be observed in, and recovered from the experimentally infected host.

Dr. Koch was trained in medicine and so his work dealt with diseases of man and animals. It was not long until his methods or principles were adopted by those interested in the diseases of plants so that we now find his postulates basic to the researches on both plant and animal diseases. The dramatic stories of how Koch and Pasteur proved that germs were the causes of diseases are still a source of fascination to students and laymen alike. The rules of proof, or postulates, are so simple, clear-cut and dramatic that they are both convincing and interesting. To carry through such an exercise with animals and human pathogens presents problems that cannot be handled in the high school or in the average college laboratory. The writer has participated, both as a student and as a teacher of bacteriology, in courses where Koch's postulates were carefully studied but not carried out experimentally because of the problems of keeping animals as well as because of the dangers involved in working with virulent human disease germs. The writer has learned through experience that in the field of plant pathology the postulates are also considered sacred. Because of the ease of handling plant material, and plant pathogens, the procedures of Koch may be carried out by all students without danger or excessive cost and with uniformly good re-

sults. This is the practice in the teaching of plant pathology.

Transfer of training is a topic familiar to educators. While teaching bacteriology at the University of Michigan the writer conceived of a transfer from his training in botany and it worked so well that he considers it worth passing on.

This is not the place to discuss the fundamental principles of biology but let us call attention to the fact that fresh fruits and vegetables are composed of living cells that respire and that they are susceptible to infections and diseases of many sorts. When a fruit rots it is suffering from a disease caused by a pathogenic bacterium or mold.

The writer has found the following exercise very effective and satisfactory. With various modifications this could be used in any high school or college course with little expense and no danger. The method, with comments, is as follows:

1. *The germ must be observed in every case of the disease.* Have students collect spoiling oranges from local stores. Store in a closed container for a day or more and almost invariably macroscopic examination will reveal the pathogen responsible for the disease. The germ involved is a green-spored species of *Penicillium*.
2. *The organism must be isolated and grown in pure culture.* This presents the problem of a culture medium. Petri dishes of agar are ideal, but for the high school lacking such facilities pieces of moist bread in closed dishes of any sort will serve as well. The bread can be sterilized along with its container by heating in a pressure cooker or by heating for an hour in a double boiler. Because of the nature of the pathogen and the host concerned, we need not worry about bacterial contaminants.

   To isolate the organism in pure culture it is merely necessary to sterilize a wire, a needle, or a knife blade by flaming, cool, touch the green spore-mass of the mold on the orange and then touch this to the sterile culture medium. Keep the culture covered to avoid air contamination and drying of the medium. Incubate at room temperature for several days. On examination it will be seen that the same green mold has grown on the culture medium. This fulfills the requirements of the second postulate.
3. *The organism, in pure culture, when re-inoculated into a susceptible host, must reproduce the disease.*

   Heat a cheap paring knife in a flame until very hot. Apply the flat side to a clean sound orange so as to sterilize a small surface area. We now have a sterile hole in a healthy orange. Using a sterile, but cool, knife or needle transfer some of the green spores from the pure culture to the sterile hole in the fruit. Prepare similar control oranges without inoculation. Store the oranges under cover to avoid infection by air borne fungus spores. Examine after several days and note the presence of the same mold and disease which were found in the original host. The disease has been reproduced.
4. *The germ must be observed in, and recovered from the experimentally infected host.*

   The completion of this step is simply a repetition of steps one and two.

In conclusion, it may be repeated that this experiment is one of the classical examples of the scientific method, it is one of great practical significance, it involves no expensive equipment or supplies and it avoids all danger of infection. It is assumed that the classroom and textbook materials will emphasize human germ diseases and show that the same procedure illustrated in this experiment must be used to identify conclusively the causal agencies of such human diseases.

A COLOR TEST THAT FAILED

W. S. DeLoach and C. E. Hofer

Southwestern Louisiana Institute, Lafayette, Louisiana

Laboratory instructors are accustomed to having test-tube experiments occasionally go wrong and fail to produce the expected results. Many tests that depend on color changes are especially prone to give trouble in the hands of inexperienced workers. What teacher of freshman chemistry, for example, has not had some students who encountered great difficulty in obtaining the brown ring in testing for the presence of the nitrate ion? When one considers the many factors—temperature, concentrations of various reagents, manner of adding reagents, presence of impurities, etc.—any one of which might be crucial in a given test, failure of students to get positive tests is understandable.

It is probably true in most cases that, when a color test fails, no distinctive color change takes place. Under such circumstances, the student, if he is "running a known," realizes that something has gone wrong and can repeat the test, re-read the directions, consult the laboratory instructor, or ask some other student "what is supposed to happen," depending on his perseverance and initiative. If a definite color change does occur, however, the student will assume, unless he knows otherwise, that the proper result has been obtained.

It is possible, of course, for a color change other than the expected one to take place. Such a case happened recently in a beginning organic laboratory. In an experiment on the properties of formic acid the oxidation of a formate was studied. Formic acid previously prepared by the student was to be neutralized with a dilute solution of sodium hydroxide and a dilute solution of potassium permanganate was then to be added dropwise. Many of the students obtained a *green* solution on the addition of the potassium permanganate, instead of the expected colorless or light brownish one. The permanganate ion is reduced to the green manganate ion in alkaline solution by a variety of reducing agents,[1] so it was assumed that a considerable excess of alkali had been added to the formic acid—the fact that 6N NaOH was at hand on the laboratory desk lent weight to this assumption. A few experiments soon demonstrated that a solution of sodium formate—prepared from the salt—does not form a green solution on the addition of potassium permanganate, but will so react if it has been made sufficiently alkaline by the addition of NaOH solution.

The author of the laboratory manual apparently did not intend for the student to obtain manganate ion formation, since his directions specifically said to *neutralize* the formic acid with *dilute* NaOH solution. However, as a result of this experiment, there are probably several students who will go through life firmly convinced that the oxidation of sodium formate by potassium permanganate is attended by the formation of a pretty green color.

[1] Mellor, J. W., *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*, Longmans, Green and Company, 1932, Vol. XII, p. 283 and 316.

Roscoe, H. E., and Schorlemmer, C., *Treatise on Chemistry*, 6th ed., MacMillan and Company, Ltd., London, 1923, p. 1185.

PROGRAM OF TWENTY-FIRST ANNUAL MEETING OF NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

Atlantic City, New Jersey, Chalfonte-Haddon Hall, February 22, 23, and 24, 1948.

OFFICERS

Ira C. Davis, President
University of Wisconsin,
Madison, Wisconsin.

Joe Young West, Vice President
State Teachers College,
Towson, Maryland.

Clarence M. Pruitt, Secretary-Treasurer
Oklahoma Agricultural and Mechanical College,
Stillwater, Oklahoma.

Earl R. Glenn, Executive Committee
State Teachers College,
Montclair, New Jersey.

N. Eldred Bingham, Executive Committee
Northwestern University,
Evanston, Illinois.

Part I—Sunday Evening, February 22, 1948.
Annual Dinner Meeting
Mandarin Room, 6:00 P.M.

Part II—Monday Morning, February 23, 1948.
Time: 9:00 A.M. Place: Sun Porch.

Report of Research Committee on Elementary Science. Glenn O. Blough, Chairman. U. S. Office of Education, Washington, D. C.

Report of Research Committee on Training of Teachers for Elementary Science. Florence G. Billig, Chairman, Wayne University, Detroit, Michigan.

Materials of Consumer Science. George G. Mallinson, Iowa State Teachers College, Cedar Falls, Iowa.

Development of Concepts in Elementary Science. M. O. Pella, University of Wisconsin, Madison, Wisconsin.

Variability in Recognizing Scientific Inquiry. Richard H. Lampkin, State Teachers College, Montclair, New Jersey.

Part II—Monday Afternoon, February 23, 1948.
Time: 2:00 P.M. Place: Sun Porch.

Joe Young West, Vice President, presiding.

Report of Research Committee on Junior High School Science.

Earl R. Glenn, Chairman, State Teachers College, Montclair, New Jersey.

Report of Research Committee on Secondary School Science. Darrell Barnard, Chairman, New York University, New York.

Meeting the Needs of Negro Science Teachers. Edward K. Weaver, State Teachers College, Montgomery, Alabama.

Suggestions for Teaching Selected Materials from the Area of the Interrelations of Living Things and Their Environment with Particular Attention to Problems of Good Land Use. Oliver S. Loud, Antioch College, Yellow Springs, Ohio.

Results of an Experimental Study in the Teaching of Biology and Social Studies. Homemade Pictures for Laboratory Teaching in Biology. Zachariah Subarsky, Bronx High School of Science, New York.

Part III—Tuesday Morning, February 24, 1948.
Time: 9:00 A.M. Place: Sun Porch.

Report of Research Committee on Training of Teachers for Secondary Schools. G. P. Cahoon, Chairman, Ohio State University, Columbus, Ohio.

Report of Research Committee on Science for Junior Colleges. William C. Van Deventer, Chairman, Stephens College, Columbia, Missouri.

Science Education Research in U. S. Office of Education. Philip G. Johnson, U. S. Office of Education, Washington, D. C.

Research in Nutrition Education in the Public Schools. Betty Lockwood, Harvard School of Public Health, Cambridge, Massachusetts.

Agricultural Science to Serve Youth. Warren P. Everote, Encyclopedia Brittanica Films, Wilmette, Illinois.

Announcements.

National Council on Elementary Science
Annual Meeting.

Atlantic City, New Jersey, Chalfonte-Haddon Hall, February 22, 1948.
Breakfast and Business Meeting at 9:30 A.M. Bakewell Room.
2:00 P.M. Sun Porch; Program: Helping Teachers in Service.
Make breakfast reservations with:

Glenn O. Blough
U.S. Office of Education,
Washington 25, D. C.

PROGRAM REGIONAL MEETING NATIONAL COUNCIL ON ELEMENTARY SCIENCE

North Hall, Netherlands Plaza Hotel
Cincinnati, Ohio
Saturday, February 14, 1948

Morning Session 9:30 – 12:00 Presiding: Cecelia Unzicker, Supervisor, Cincinnati Public Schools

HOW DO EXPERIENCES IN ELEMENTARY SCIENCE CONTRIBUTE TO GROWTH AND DEVELOPMENT OF CHILDREN?

In Primary Grades: Etheleen Daniels, Supervisor Elementary Education, Montgomery County Maryland.

In Intermediate Grades: Paul E. Blackwood, Assistant Specialist in Elementary Science, U. S. Office of Education.

HOW DO VARIOUS SCIENCE ACTIVITIES HELP TO BRING ABOUT THIS GROWTH AND DEVELOPMENT?

Experiments—Charles K. Arey, Assistant Professor of Education, University of Alabama, University, Alabama.

Reading—Verna Walters, Supervisor, Elementary Curriculum, State Department of Education, Ohio.

Observing—Margaret Hampel, Supervisor, Teacher Education, Elementary School, A & M College, Stillwater, Oklahoma.

Discussion

Afternoon Session 2:00 – 4:00 Presiding: Rose Lammel, Teachers College, Columbia University, New York City

HOW CAN CLASSROOM TEACHERS IMPROVE IN ABILITY TO TEACH SCIENCE?

Jennie Campbell, Director of Elementary Education, State Department of Education, Utah.

Myrtle Townsend, Helping Teacher, State Department of Education, New Jersey.

Anna E. Burgess, Directing Principal, Cleveland Public Schools.

Ruth Scribner, Consultant in Science, Minneapolis Public Schools.

Bonnie Howard, Supervisor Intermediate Grades, Louisville Kentucky Public Schools.

Pearl M. Wright, Principal, Cincinnati Public Schools.

Helen Betty Newman, Teacher, Clifton School, Cincinnati, Ohio.

EXHIBIT OF CHILDREN'S SCIENCE WORK—CINCINNATI PUBLIC SCHOOLS—IN NORTH HALL

NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS.
Twenty-sixth Annual Meeting
Indianapolis, Indiana, Claypool Hotel,
April 2 and 3, 1948.

More than fifty topics are listed on the program. The topics range from "Elementary Arithmetic in an Activity Program" to "Coordinating High School and College Mathematics." Although topics concerning the philosophy of teaching mathematics have not been omitted the emphasis seems to be on methods and special techniques in mathematics teaching. There will be a continuous showing of the latest visual aids in teaching mathematics.

NEW DESIGN FOR ATOM RESEARCH EQUIPMENT

A. W. HASLETT

THE Nuffield Laboratory of the University of Birmingham, England, hopes soon to have the most powerful equipment in the world for the bombardment of the atom.

Its director, Professor M. L. E. Oliphant, an Australian-born physicist who worked at the Cavendish Laboratory, Cambridge, during its greatest period of nuclear discovery, was at one time chief research assistant to Lord Rutherford.

His success, if achieved, will be the result of applying engineering ingenuity to a problem which, until lately, had looked like resolving itself into a competition in expenditure—with the main item, the provision of bigger and better cyclotrons.

Where the target is the atom, physicists use two quite different types of unit to describe the efficiency of their equipment. They rate the energy of their bombarding particles in MeV—one MeV being the

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energy which an electron acquires in being accelerated through one million volts. And they reckon the cost of their equipment in "megabucks" mega standing for a million. It is only by taking these two figures in conjunction that the full significance of Professor Oliphant's design achievement can be appreciated.

The cost of the new Harvard cyclotron, designed to produce perhaps 200 MeV particles, has been estimated at $500,000. Professor E. O. Lawrence in California will have spent $2,000,000 on the installation of a 184-inch cyclotron to give him bombarding particles of perhaps 400 MeV energy. And, if a 1,000 MeV cyclotron could be built, the cost would probably be around $10,000,000.

Lower Cost

By contrast, Professor Oliphant reckons to produce protons of 1,000 MeV energy at the cost of a mere $550,000. And there seems no reason why, by the use of this new technique of design, particles of still higher energies should not be produced.

The improvement which he has effected can best be understood in relation to the ordinary cyclotron. This extremely ingenious device, which was invented by Professor Lawrence in 1935, depends for its working on the fact that any electrically charged particle can be made to move in a circular course by applying a sufficiently powerful magnetic field in a direction at right angles to the plane in which the particles are to revolve.

Given this fact as a starting point, it is only necessary to arrange for the particles to be given a series of small, but regularly repeated increases in forward speed—in practice twice in each revolution—for their energies to be built up to any desired level. The aim, in fact is to give the particles a series of small accelerations, instead of a single big acceleration, which would demand an impossibly high voltage to produce it.

In any ordinary cyclotron, the particles start their journey at the center of a disc-shaped chamber, and move outwards along a spiral course, the radius of which increases with their speed. Above and below the chamber round which they are whirled are the two halves of a giant magnet, also of circular shape. And the main practical limitation to the speed which the particles can be given lies in the size to which such a magnet can be built.

The main intention behind Professor Oliphant's design is to get away from the need to build larger and larger circular magnets. The idea on which it is based was first suggested by Professor Veksler of Moscow. Professor Oliphant was, however, already considering it at the time. A little later, the same idea was independently put forward by Dr. Macmillan of Berkeley University (California). Professor Oliphant's boldness is in applying it, in a single step, to produce the high-energy protons needed for nuclear transmutations.

Why not, all three men argued, design a system in which the whirling particles, instead of being allowed to spiral over the whole area of a large circle, would be confined, like track runners, to a relatively narrow circular course round the outer edge. In that case, it would be enough to provide a ring-shaped magnet, with its two poles above and below the speed track, instead of a circular magnet covering also what—at an athletic meeting—would be the unused circle of grass inside.

Professor Oliphant's magnet will take the form of a 32-feet ring—compared with a diameter of just over 15 feet for the largest circular magnet yet designed. It will be laminated, and built up on the site. The manufacturer will be required to roll wedge-shaped iron sheeting, of which the thickness must vary uniformly from one edge to another, and to secure uniformity round the complete disc. Special equipment will be needed to machine the magnet to its final shape.

In order to keep the protons to the prescribed circular course, it will be necessary to increase simultaneously, during each operation of the equipment, both the magnetic force exercised by the magnet, and

the frequency with which successive forward accelerations are given to the particles. The latter is equivalent to varying the frequency of a radio transmitter from 300 Kc to 10,000 Kc in the course of a second.

All these difficulties have been fully looked into, and Professor Oliphant has now decided that he can confidently go ahead. He has been given a British Government grant by the Department of Scientific and Industrial Research, and the concrete foundations have already been prepared. The principal contracts have also been given. By next summer he hopes that his 1,000 tons electromagnet will be in position, and within 18 months to two years the complete equipment should be working. It will be known as a "proton synchotron."

Seven Million Circuits

When working, it will be in effective operation for about one second in every ten. During this second, the protons which it accelerates will make seven million circuits of the speed track, and will travel a distance equivalent to going ten times round the earth. When they emerge, they will be traveling at a speed equal to nine-tenths of that of light.

Like the similar particles produced by cyclotrons, they can be used either directly for the bombardment of other nuclei, or the release of neutrons of equally great energies which can in turn be used for nuclear bombardment. In either case the main interest will lie in the way in which they are scattered by the nuclei which they hit; in the possible new types of transmutation which may result; and in the liberation, on a relatively large scale, of the new meson particles, the existence of which was first predicted by the Japanese physicist, Yakava, and which are believed to play the part of nuclear glue.

It is probable that, even before the first "proton synchotron" has been brought into service, other and even more powerful equipments will be under design; and that the idea, to which Professor Oliphant has first given practical shape, will prove capable of still more spectacular development.

BRITAIN'S NATIONAL PHYSICAL LABORATORY

W. H. OWENS

AT one of the world's most interesting research centers a body of British scientists are working to find the answers to modern industrial problems. Day by day these experts of the National Physical Laboratory at Teddington, near London, carry out intricate tests and elaborate experiments which are designed further to improve the high standard of technical skill and accuracy in British craftsmanship and manufacture. No problem is ever too difficult for them.

Quite recently they built a scale model of Britain's House of Commons (as it is being reconstructed after wreckage through aerial bombardment in World War II) for the purpose of finding an ideal ventilation system for the Westminster debating chamber. Another test model, but of quite a different kind, reproduces in miniature the water flow and motion of the tides at the mouth of the Tigris and Euphrates rivers. This amazing piece of apparatus can show the effects of a whole year's tides in the space of only nine hours. It is used for experiments to assist the engineers who are responsible for the dredging of the difficult navigational channels in the river estuaries.

The experimental work at the National Physical Laboratory is very wide in scope and the Laboratory is divided into 10 divisions, each of which covers a particular subject. There are Divisions for Physics, Light, Engineering, Electricity, Aerodynamics, Radio, Metrology, Metallurgy,

Mathematics (including Statistics), and Ship Design.

Rigid and Exacting Tests

Britain's great rebuilding and housing program calls for the use of many new materials. So in the Physics Division at the Laboratory these materials undergo a series of rigid and exacting tests to ensure they will conform to the requirements of builders. In the same division is an acoustics section where new methods of sound-proofing walls are tried out. The results of this work will bring lasting benefits to the community, especially those who live in apartments. The scientists have also done much to reduce the noise of machinery in factories, which in the past has often affected the output of workers. Britain's trains and road vehicles run more quietly and smoothly today, thanks to the work of the scientists.

In the Light Division they test every kind of illumination for homes, factories, shops, offices, coal mines and streets. With an apparatus known as the photo-electric recording photometer, continuous records of daylight illumination have been made over a number of years. These records are used in connection with work on problems of lighting in the design of new buildings. Among other matters that occupy these Light Division scientists are investigations into new types of ships' navigational lights and rear reflectors for bicycles.

Aeronautical researches carried out on models at the National Physical Laboratory, in connection with the full-scale work at the Royal Aircraft Establishment, have been a vital factor in the rapid development of British aircraft. Models of every new type of aircraft are tested through the controlled air streams of wind tunnels, through which currents of air may be passed up to more than 600 miles per hour. A special high-speed wind tunnel is used for research at speeds approaching that of sound.

The Whirling Arm

Among the latest apparatus in the Aerodynamics Division is the Whirling Arm, which tests the changing forces on an aircraft when it departs from straight flight. A model aircraft is mounted at the end of an arm which revolves through air at about 65 miles per hour.

The Meteorology Division is occupied with testing scientific measuring instruments. British clocks, watches, chronometers, industrial gauges and so on have a high reputation for accuracy. This is because each manufacturer aims to obtain a test certificate from Teddington before marketing his product. A watch is tested in various positions and temperatures over many weeks, and even if the average daily loss or gain is but one-fifth second it may not obtain highest grading.

In the Ship Division stability and water resistance tests are made with scale models in huge water tanks where waves and wind currents are created artificially. Models are towed by an electrically-propelled carriage on rails at the side of each tank. From their performances, the behavior of the full-scale ship on the high seas can be predicted.

Models of Mulberry Harbors

During World War II scientists at the National Physical Laboratory were engaged on vital war-winning problems. Their efforts played no small part in the final victory, for almost every problem which affected the waging of war on land, at sea and in the air came under scrutiny. One group studied the problem of meteorological observation by radio, another military camouflage, a third the degaussing of ships for protection against magnetic mines, a fourth developed new armor-piercing projectiles, and so on. British supremacy in the early application of radiolocation was largely due to the research made by these scientists. And it was at Teddington that models of the famous Mulberry harbors, used in the invasion of Europe, underwent the first tests in tanks to find, and to reduce where possible, the power necessary for towing, both in smooth water and in waves, and to improve their handling properties.

DETERMINING THE POSITION OF THE ENZYME ALKALINE PHOSPHATASE BY HISTOLOGICAL METHODS

HARVEY KAMINOFF

Taft High School, New York, New York

THE project I carried out in our biology laboratory dealt with a certain enzyme and the technique used to determine its position in the cell.

In certain cells such as kidney, intestinal, bone, etc., there is found an enzyme called alkaline phosphatase. Before I go any further, let us review what an enzyme is. All of you, whether you know it or not, have had some access to enzymes. When you chew starch, a certain enzyme in your mouth changes the starch to sugar. Those of you who have taken elementary chemistry and general science, have learned that when you prepare oxygen by heating potassium chlorate and manganese dioxide that the manganese dioxide acts at a catalyst, that it speeds up the rate of the reaction. This is just what an enzyme is, an organic catalyst. It speeds up certain organic processes such as fermentation of sugar, conversion of starch into sugar, and so on. The enzyme that I worked with, alkaline phosphatase, has the job of changing certain compounds of phosphoric acid called esters, into phosphates. These phosphates are used by our body in the formation of bone.

While reading some of the latest advances in histology which is the preparation of tissues for microscopic examination, I came across two articles written on the subject of phosphatase enzyme. One was written by George Gomori and appeared in the 1939 *American Journal of Pathology*. The other by J. F. Danelly and appeared in the 1943 *Journal of Experimental Biology*. Becoming interested in their work, I decided to repeat some of their experiments as a basis for later research to be carried on in this field.

Although the theoretical information came from these articles, a great deal of personal research had to be carried on to perfect the techniques necessary for my work.

The original work in this field was done by Robinson who observed that if a section of bone tissue which contains the enzyme was incubated in a solution of a compound upon which the enzyme acts that calcium phosphate is deposited in the cell at the site of the enzyme activity. This fact was used as a basis for all future work in this field.

And now to present the methods used for the location of the phosphatase enzyme. Before I do this, may we run through the histological methods used for preparing tissue for microscopic examination. First, tissue is removed from the body of the animal and put into fixing agent to kill the tissue and preserve cell contents. The tissue is then washed to remove any fixing agent that remains. Then it is transferred into alcohol to dehydrate it, that is to remove all water. Next, the tissue is put into a clearing agent to render the cell transparent. The tissue is then embedded in paraffin in order that it may be sectioned easily. The block of paraffin is put into a microtome, an instrument that cuts very thin slices of a tissue. After the tissue is sectioned, it is fixed to a slide, stained and mounted. It is now a permanent slide which can be observed for many years.

The techniques I used in my work in locating the phosphatase enzyme are practically the same. Rat kidneys were the tissues used. After the kidneys were removed from the rat they were fixed in 80 per cent alcohol for about 8 to 24 hours. Next, they were dehydrated in 100 per cent alcohol for about 24 hours. Then cleared in cedarwood oil, embedded in paraffin and sectioned. The sections were fastened on to a slide and prepared for staining. Up to now, there has been no deviation from general histologic technique.

In ordinary technique, staining would be the next step. I, however, then incubated the sections in the solution upon which the enzyme acts. The solution contains a compound of phosphoric acid, namely, sodium glycerophosphate, and it is upon this compound that the enzyme acts.

The incubation process involved the immersion of the sections in the aforementioned solution. The sections are put into an incubation for about 24 hours. After 24 hours of incubation, the slides are removed, but the calcium phosphate which is deposited in the cell could not be seen. Hence it became necessary to further treat the sections. First the slides were immersed in cobalt nitrate. This changed the calcium phosphate to cobalt phosphate. Then the sections were treated with ammonium sulfide which changed the cobalt phosphate to cobalt sulfide. The cobalt sulfide is black, hence at the original site of enzyme activity there appears a black stain. After this, the sections are mounted in canada balsam. We now have a prepared slide of a section of a kidney stained to show where the enzyme alkaline phosphatase is located.

Using these preliminary facts and techniques as a basis, I intend to carry on further research along these lines. For instance, is there any significant loss of enzyme activity due to the killing processes? Are the sites of calcium phosphate precipitation really the sites of enzyme activity? Or does the calcium phosphate diffuse throughout the cell? I also intend to try these techniques for the location of other enzymes.

Another phase of this problem I intend investigating is the relation of this enzyme to certain bone diseases as rickets. It has been observed that in rickets the amount of enzyme is considerably increased.

BOOK REVIEWS

HAND, HAROLD C. (Editor). *Living in the Atomic Age*. Urbana, Illinois: Bureau of Educational Research, College of Education. 1946. 59 p.

This is a resource unit for teachers in secondary schools. The authors are to be commended highly for compiling such a useful handbook—as useful for the social studies or English teacher, the high school librarian as the science teacher. The reviewer wishes it were possible to print the pamphlet in toto. The six parts are as follows: 1. Introductory comments, 2. Orientation for the teacher: nuclear developments and their major social implications, 3. Objectives: "plus" qualities of the effective citizen in the atomic age, 4. Pupil's questions: what high school boys and girls want to know about nuclear energy, the atom bomb, and related matters, 5. Suggested learning experiences, and 6. Selected bibliography. Only in the latter phase is the pamphlet somewhat incomplete as it fails to list some good articles in print at the time the pamphlet was published. —C. M. P.

BAYLES, ERNEST E., AND MILLS, ARTHUR L. *Basic Chemistry*. New York: The Macmillan Company, 1947. 720 p. $3.00.

Basic Chemistry is based on the idea "that students and teachers are working together on reflective, or scientific, studies of problems with which they are concerned. Reflective study begins with a problem." Consequently the title of each unit and chapter is stated as a question, and the question is central to the unit or chapter. It is asserted that this offers an entirely new approach to the study of chemistry and that there are four important points of differences between it and the traditional type of textbook.

The first is that it is sequentially organized so that each unit and chapter prepares for an understanding of the next. The second is that it treats the various elements and compounds in relationship by grouping kindred topics. As a result, the study of colloids is placed near the front part of the text to be studied along with mixtures.

The third major difference is the logical arrangement of the tool subjects of chemistry. In most texts these topics are treated at various points in the book, but here they are presented in the first four units.

The fourth major difference is the consistent emphasis upon the scientific or reflective method of thinking as a means of making learning functional and permanent.

At the end of each chapter are questions for review or further study and a list of books for further reading. Suggested experiments are

found among the textual material. Units are as follows: (1) What is the nature of a scientific study of chemistry? (2) What happens to matter when it undergoes chemical change? (3) What happens when substances mix, especially with water, without changing chemically? (4) How does a chemist represent chemical changes? (5) What should we believe about the subatomic structure of matter? (6) How does the concept of ionization help us understand chemical reactions? (7) Can the elements be arranged in groups useful for predicting their properties? (8) What part do the non-metals nitrogen and sulfur play in the affairs of the world? (9) What is the present and probably future significance of chemistry?

—C. M. P.

SANDERS, EDWIN F. *Practical Biology.* New York: D. Van Nostrand Company, 1947. 618 p. $3.00.

Practical Biology is quite different from most secondary school biology textbooks that have been published within recent years. Both in organization and content it departs from the tendencies of recent years. Possibly for that very reason it may fill a need.

The author states in the preface that "the organization of *Practical Biology* follows the natural order as opposed to the integrated type of text. The student makes an intensive study of structure and organism types, one after another, learning all that is needed for his understanding of functional aspects and adaptations. The main emphasis, however, is placed upon work, accomplishments and uses of structures to man and to the rest of the living world generally." In keeping with this viewpoint such usual phases of biology as health, disease, sanitation, and so on receive very brief or almost no mention. It would almost seem as if certain phases of biology were taboo. On the other hand there are some phases of biology that receive excellent treatment—soil and forest conservation, birds, leaves, stems, roots, and so on. Most biology teachers would probably prefer to use this book as a reference rather than a basal text.

—C. M. P.

WEAVER, ELBERT COOK, AND FOSTER, LAWRENCE STANDLEY. *Chemistry for Our Times.* New York: McGraw-Hill Book Company, 1947. 738 p. $2.48.

The general approach of this secondary chemistry text is inductive and a historical approach is employed to familiarize students with outstanding developments in chemistry and leaders in chemical research. Understanding the environment, the method of science, and the applications of chemistry to the life activities of the average citizen are stated as important aims of the text. Thus emphasis is placed on the chemistry of the household, the garden, first-aid, textiles, plastics, paper, photography, and other hobbies.

New vocabulary terms are listed at the bottom of the first page of most new chapters. A series of questions are often found interspersed with the textual material, and at the end of each chapter is a summary, a further list of questions, and a list of "more challenging questions." There are 376 illustrations. There is a teacher's manual which lists discussion topics, references, lists of supplementary books, and answers to questions and problems.

Units are as follows: (1) Our essential environment, (2) Chemistry's business office, (3) Dispersions of matter, (4) Chemistry of the earth's crust, (5) Chemical industries, (6) The metals, (7) The chemistry of carbon compounds, (8) Chemistry and human problems, and (9) Additional topics.

—C. M. P.

ROBBINS, JACK, AND WAYNE, ALAN. *Directed Experiments in Biology.* New York: College Entrance Book Company, 1947. 118 p.

This is a laboratory manual that can be used with any textbook. Cross-references for each of fifty-six experiments are made to twenty-six of the better known high school biology textbooks. The pupils, for the most part, make brief answers to questions and observations and construct and label drawings.

This laboratory manual will serve a very useful purpose for those classes desiring a laboratory manual suitable for use with a number of textbooks.

G. B. K.

JOHN, W. D. *Modern Polishes and Specialties.* Brooklyn: Chemical Publishing Company, 1947. 313 p. $7.50.

This is a practical volume for anyone interested in the commercial production of any type of polishing material. There are over 700 successfully developed formulas. Science classes will find useful material here in the modern polishes for the automobile, household powders, cleaners and polishers. Much information is given about the sources, preparation and properties of materials used in various types of cleaners and polishers.

—W. G. W.

DE MENT, JACK, AND DAKE, H. C. *Uranium and Atomic Power.* Brooklyn: Chemical Publishing Company, 1945. 343 p. $4.00.

We have in this volume the underlying principles and theories essential to an understanding of atomic power. The chapters cover Atomic Power, the Uranium Minerals, Prospecting for Uranium Minerals, the Physics of Uranium, Chemistry of Uranium, Specific Methods in Uranometry, Special Methods in Uranometry,

Bibliography and Tables, and a final chapter on The Atomic Bomb. The subject covers material as far as information had been released up to the time of publication.

—W. G. W.

WILSON, SHERMAN R., AND MULLINS, MARY R. *Applied Chemistry.* New York: Henry Holt and Company, 1947. 714 p. $2.36.

This is the revised edition of a text first published in 1939. Intended for the non-academic high school student, it emphasizes consumer and applied chemistry. There is much less emphasis upon theory and the mathematical aspects of chemistry, although the latter is far from neglected. There are units on fire and fuels, foods, textiles, dyes, bleaching agents, household cleansing agents, disinfectants and antiseptics, building materials, photography, drugs, poisons, and cosmetics.

Each unit has a summary of the main ideas of the unit, a list of review questions, a suggested list of projects, and some student laboratory experiments. There are 80 of these experiments found in the text. The appendix among other things has a comparison of the fahrenheit and centigrade scales, table of solubilities, a glossary, a table of familiar chemicals, a reference list, and a list of examination questions.

Suitable as a text in many more chemistry classes than it is now used, it is one of the finest supplementary text references that any chemistry teacher is likely to find.

—C. M. P.

HAWKINS, MAXWELL. *Torpedoes Away, Sir!* New York: Henry Holt and Company, 1946. 268 p. $2.00.

Torpedoes Away, Sir! is the story of our submarine navy in the Pacific. Anecdotes are told about real men and real submarines. The account is accurate and the illustrations include about thirty official U. S. Navy photographs. The incidents described are based an experiences of men in submarines.

Altogether this is a story of thrilling adventure that will appeal to boys of high school age.

—G. E. D.

KINERT, REED. *Our Fighting Planes.* New York: The Macmillan Company, 1947. 160 p. $3.75.

Our Fighting Planes is the story of the United States military aircraft of World War II. The text is dramatic and clear, and the technical data is complete and accurate. The 75 full page illustrations showing the planes in action reflect not only power and fighting force but also the beauty and strength of the planes themselves. Several illustrations are in color.

This is a record of America's air achievement in World War II and a part of our nation's history.

Boys interested in learning about different kinds of planes and in the construction of model planes will appreciate this book.

—G. E. D.

WEISBRUCH, FRED T. *Semimicro Laboratory Exercises in High School Chemistry.* Boston: D. C. Heath and Company, 1946. 269 p. $1.48.

This manual outlines 62 experiments, which cover the usual field of high school chemistry. Most of the experiments require a double laboratory period. The order of use may vary depending upon the order of topics in the text studied. An innovation used here is that of introducing the use of semimicro methods to the high school pupils. The claims that these methods make the work more interesting to the pupil seem reasonable. The system undoubtedly does require the pupil to use greater concentration in his work. Very little new equipment is required for this work, and other teachers may find, as has the author, that chemistry becomes more meaningful and interesting to the pupils.

—W. G. W.

SCOTT, HERSHEL N., AND MACCALLUM, CHARLES L. *New Age General Science Text Workbook.* Chicago: Austin Publishing Company, 1946. 199 p.

This attractive workbook has a 12" x 9" page and opens up flat on a spiral wire binding. There are 12 units as follows: The Green Plant, Your Body, Community Health, Water, Weather, The Planet Earth, Heat and Fire, Electricity, Communication, Travel, Transport, and Light. This book has short bits of textual material, experiments, and questions on both text and experiments. There are blank spaces for pupils' records, and space is also provided for definitions of new words. The many diagrams are well drawn and add greatly to the value of the book.

—W. G. W.

SISKIND, CHARLES S. *Electricity: Principles, Practice Experiments.* New York: McGraw-Hill Book Company, 1947. 448 p. $2.50.

This book has the threefold purpose of presenting the general elementary principles of direct and alternating current electricity, showing how these principles apply to the construction and operating characteristics of the more common types of circuits, devices, and machines, and to illustrate how these principles may be verified by the performance of simple experiments with easily obtainable and readily constructed apparatus.

It is intended that the book be used in senior high schools, vocational schools, junior colleges, technical institute classes, and short courses given to non-electrical engineering students.

—S.M.A.

ANONYMOUS. *Trees for Tomorrow.* Washington: American Forest Products Industries, Inc. (1319 18th Street N.W.), 1947. 62 p. Free.

This is a very interesting booklet on the Trees of America. There are many fine illustrations and much interesting information. For example Montgomery County Ohio with 104 species of trees has more than the whole of Europe (not counting Russia) which has 85. The United States has more than 1,000 species—England has only 29, France 34, and Germany 60. England has no native gums, hickories, sassafrass, tuliptrees, or buttonwoods.

This is especially recommended to all elementary science teachers, general science, and biology teachers. Charts and posters are available for the asking.

—R. J. A.

SETON, ERNEST THOMPSON. *Wild Animals I Have Known.* New York: Bantam Books, 1946. 149 p. $0.25.

Here is a famous book complete and unabridged in a Bantam book edition made possible by the effective promotion of the original edition. This edition needs no introduction, for it has long been known as one of the most successful of animal books because of the true stories of the animals Mr. Seton found in Canada, Europe, and America and the fascinating way he tells these stories and illustrates them with his own drawings.

—G. O.

INGLES, LLOYD GLENN. *Mammals of California.* Stanford University: Stanford University Press, 1947. 258 p. $4.00.

This book is especially designed for the student or amateur, but will serve as a valuable ready reference handbook for the professional. The natural history accounts are most interestingly written and at the same time fairly comprehensive. Excellent photographs and range maps add much to the usefulness of the book. Its keys make for easy identification of species of mammals found in California. General science, biology and elementary science teachers and students of that state will find this a most valuable reference. Similar teachers and students in other states will find the treatise of only slightly less use, as so many of the mammals are found in other states.

—F. M. D.

STILL, ALFRED. *Communication 'Through the Ages.'* New York: Murray Hill Books, Inc., 1946. 201 p. $2.75.

Through the ages man has conveyed messages and information to other men in distant places, ever-increasing distances with ever-increasing speed. The old-time drummings, smoke signals and semaphores did not adequately transmit *ideas.* The same can be said for even our modern means of communication. Language is not a perfect means of communication; a code of some sort is usually actually employed.

The discovery of current electricity and its mobility was a great step forward. Telegraph, telephone, radio, and television have followed in a relatively short time. The author has presented an interesting account of the scientific background of communication. Numerous illustrations, both technical and picturesque add much to the account. The author was Professor of Electrical Engineering at Purdue University for 21 years before his recent retirement. He has written extensively on various phases of electricity and magnetism.

—F. M. D.

STEVENSON, O. J. *The Talking Wire: The Story of Alexander Graham Bell.* New York: Julian Bessner, Inc., 1947. 207 p. $2.50.

If readers both young and old could see this attractive little book and read the information on the jacket they would want to read the book at once. What a mission Alexander Graham Bell picked out for himself in life! He early began experiments in speech and sound. His mother was deaf and he, when a young man, married a deaf girl. He taught a deaf boy and always kept up his interest in aiding the deaf to be able to learn and communicate with others.

The invention of the telephone proved to be a long, hard experiment. Ill health and lack of money might have caused him to give up, but he was definite in his purpose and finally achieved his goal. In 1875 he invented the telephone and was just in time, and the patent was granted to him. He lived in Scotland, Canada and the United States. He, like Edison, spent some of his most interesting boyhood and early manhood days in Boston.

Dr. Stevenson the author of this very fine story attended school in Brantford, Ontario, where Alexander Graham Bell went with his parents to live when they first came to Canada. It was here, later while on vacation from Boston, that the idea and experimenting with the telephone went on, for with Bell it was ever uppermost in his mind, until he had really made it operate and work. He was greatly pleased when he was asked to demonstrate the new invention to Queen Victoria.

The Bell home was named Beinn Bhreagh, which meant, "beautiful mountain." Dr. Gilbert Grosvenor and Dr. David Fairchild, were his sons-in-law, each to become distinguished, the former as editor of the *National Geographic Magazine* and the latter as a plant explorer.

The book is illustrated by Lawrence Dresser, who studied Art in New York and Paris and is especially interested in book illustration and enjoys "period books."

—F. M. D.

GARST, SHANNON. *Amelia Earhart, Heroine of the Skies.* New York: Julian Messner, Inc., 1947. 190 p. $2.50.

Shannon Garst has written a story of this great heroine of the sky with warmth and understanding, revealing a great human character from childhood adventures, when "everything was fun," through sprouting wings and fame and honors galore and a dazzling record of firsts, to the great adventure which the world considered so tragic but which Amelia would never regard as tragic so intent was she on promoting and improving women's place in the air. Young and old will love this book.

—G. O.

GARBEDIAN, GORDON H. *Thomas Alva Edison: Builder of Civilization.* New York: Julian Messner, Inc., 1947. 231 p. $2.50.

A very fine article about Thomas Alva Edison appeared in the *Scientific Monthly* in February (1947) which I read with great interest. The pictures which accompany this article of Glenmont and Edison at fourteen years of age, and then as he looked perhaps when eighty-four years of age can be greatly appreciated by all of us. The article and then the tribute paid to Edison over the radio on the centennial celebration of the great inventor's birth made me wish I could read a good biography of Edison and learn more about him and his work. Only a few days and this very excellent story of the life of Edison as told by Garbedian came to my hand. Thomas Alva Edison was no doubt one of the greatest men that ever lived and did far more for his fellow men than we as a people realize. We are proud of his great achievements; we are proud of the example he set before others and above all, we are proud of his unselfish endeavor in the betterment of mankind. There is nothing so dynamic as change and Edison accepted change; in fact he, by his inventive mind and mechanical and scientific ability, was able to effect great changes almost over night. He was always mindful that he must help educate and prepare the people for the changes that would come about as a result of some invention of his. For example he literally had to argue and prove that electricity would soon be so cheap for lighting purposes in New York City that only bankers and the rich would any longer be able to afford gas as an illuminant.

He received scarcely no education at all except what his mother taught him, yet he was practically and culturally a well educated man. His whole life was one round of enthusiastic activity after another. For some four years of his teenage years he was a "rolling stone" and had it not been for a good friend by the name of Adams in Boston who spoke well of him to others and helped him to find employment he might have lost even more time before settling down to his life work in the field of science and invention.

New York City and New Jersey became the locale where he could best work. He belongs in that great school of free enterprisers who at an early age, struck out on their own to earn a living first by their own labor and then by production and making wages and labor for others.

Thomas Alva Edison was a capitalist—a good capitalist. He was a successful capitalist and business man, and made work for large numbers of men. In one instance it mentions fifteen hundred men were employed but there may have been even more at times.

The men who worked for him held him in high esteem and spoke of him as "the old man" or "the chief." He had a fine sense of humor and was rather unmindful of his appearance and dress.

It has just come to light upon opening Edison's old desk that he knew about uranium and materials and possibilities no noubt of nuclear energy and the atomic bomb. If he were living today it is safe to predict that he would use that discovery in the interest of peace as rapidly as his great mind and facilities would permit. His keen sense of observation, his ability to let one discovery or invention lead him on to another, made for a constant flow of patents and achievements to his credit and honor.

In the back of this interesting book written by Garbedian is a chronological table of events in the life of Edison and a selected bibliography of Edison and his work.

On the inside of the attractive jacket is a list of Julian Messner's biographical publications similar to Garbedian's life of Edison which readers might like to examine and own.

Edison made work and capital for himself and others; he made a full and good life for himself and others. What more can a man do for his country and fellowmen? Edison scorned the idea of getting old and at the youthful age of seventy-five remarked, "I'm looking ahead. I've got enough ideas for new inventions to keep me busy for a hundred years more!"

—F. M. D.

PERRY, JOSEPHINE. *The Plastics Industry.* New York: Longmans, Green and Company, 1947. 127 p. $2.00.

This is the latest of the *America at Work* series, all of which have been reviewed in SCIENCE EDUCATION. As in the preceding books, the text has been kept free from tedious, involved technical descriptions of manufacturing processes. And yet enough technical information and background material is presented for a good understanding of this relatively young and increasingly important industry. More than three score photographic illustrations supplement the textual material.

Plastics are materials capable of being modeled or molded into various forms. Clay was the first plastic material, being used by

the Egyptians for making clay vessels as early as 7000 B.C.

The first modern plastic was Celluloid developed by the American John Hyatt in 1868. Bakelite developed in 1863 was the first synthetic resin plastic (from the interaction of carbolic acid and formaldehyde).

The four principal types of plastics are the synthetic resins, natural resins, the cellulose plastics, and the protein plastics. Linters and wood pulp are the basic raw materials for cellulose plastics while casein from milk and soybean meal are the basic raw materials for protein plastics.

So many things are now made from plastics and the list will be even greater in the future: plexiglass, insulation, laminated plastics, textiles, lenses, shoes, fabrics, wood, and so on.

—G. B. K.

PERRY, JOSEPHINE. *The Rubber Industry.* New York: Longmans, Green and Company, 1946. 127 p. $2.00.

This new and revised edition of Miss Perry's earlier volume on the rubber industry gives a concise and accurate picture of pioneering science in a fascinating field. The text is confined to factual material gathered as much as possible from industry itself thus insuring an authentic account of the growth and development of a great industry with its thrilling achievement in producing synthetic rubber. There are twelve chapters in this small book dealing with the growing of rubber and the growth of the rubber industry and rubber goods. There is a chapter on research in the rubber industry and the need for scientists in engineering research. School libraries will welcome such a book as this for the accurate picture it gives of the means employed to produce the highest quality of rubber goods in the world.

—G. O.

PERRY, JOSEPHINE. *The Light Metals Industry.* New York: Longmans, Green and Company, Inc., 1947. 128 p. $2.00.

The two light metals discussed in this book are aluminum and magnesium.

In the first part of the book we learn about the source of each metal and distribution throughout the world, as well as the use that can be made of the metals. The history, reduction, manufacture and methods of fabrication are given.

The lightness of aluminum and magnesium will make for more extensive use of the metals in the near future. The Dow Chemical Company has recently made a wheelbarrow which might serve as a symbol of the usefulness of magnesium in the manufacture of all kinds of weight-saving equipment. This wheelbarrow weighs just thirty pounds and has the same load carrying capacity as an ordinary standard heavy-duty wheelbarrow that weighs eighty-five pounds. The workman has fifty-five pounds less dead weight to move with the magnesium wheelbarrow. In other words, he can move a load fifty-five pounds heavier than he can with the old-fashioned steel wheelbarrow. And what applies to the wheelbarrow applies to thousands of other pieces of equipment where dead weight has to be moved by either man power or motor power.

The heart of the light metal industry is careful, painstaking research which has gone forward steadily since the days when two young men, who were little more than boys, were doing their history-making experimental work in makeshift laboratories in Ohio. It is fitting that one of the youngest of all of the American industries should have been conceived by these two young men, Charles Martin Hall and Herbert H. Dow. The light metals industry symbolizes the great growth of modern scientific industries whose magnitude and importance have had marked influence in lifting the nation to a status of industrial independence.

Clear, captioned photographs makes the textual material more meaningful.

Other books written by the author in the *America at Work* series are the following industries: chemical, coal, cotton, electrical, fish, glass, paper, plastic, petroleum, rubber and steel.

—G. B. K.

COTHREN, MARION B. *This Is the Moon.* New York: Coward McCann, Inc., 1946. 87 p. $2.00.

Here is a book about the moon so correct in its information but reading like a fascinating story. In *This Is the Moon,* the reader takes a jaunt around the world and finds out what other people think about the moon. In myths as charming as any fairy tale, Marion B. Cothren, gives the beliefs and superstitions about the moon among the Chinese, Hindus, Japanese, and among our own American Indians. Such questions as these are answered in *This Is the Moon:* What is the moon like? What is the man in the moon? Why is the moon yellow? What makes the moon change its shape? What makes the tides? This delightful book should be among our science books for children.

—G. O.

CROSS, JOHN KIER. *The Angry Planet.* New York: Coward McCann, Inc., 1945. 239 p. $2.00.

If you want to enjoy a fantastic and thrilling story of a rocket-ship to Mars, read *The Angry Planet,* a story after the fashion of Jules Verne with strange and unusual illustrations by Robin Jaques to convey the mystery, terror, and beauty of the incredible events which took place when the famous Scotch scientist, Dr. Andrew McGillivray, and the equally famous English

novelist, Stephen McFarlane climaxed a lifelong ambition and dream of a flight to Mars. What the professor did not know, however, was that a boy and girl had stowed away on their ship, the Albatross. The book is crammed full of excitement and adventure and gives the reader food for serious thought.

—G. O.

KNAPP, SALLY. *New Wings for Women.* New York: Thomas Y. Crowell Company, 1946. 179 p. $2.50.

Sally Knapp, who wrote *New Wings for Women,* has led as varied and interesting a life as the women she describes in her book which combines a wish to help young people in choosing their vocations with interest in aviation. Women have worked along with men for the advancement of aviation and have made good in this so-called man's field, but their stories are not as well known to the air-minded laymen. *New Wings for Women* tells their story, for here is a group of biographies about women in aviation: Pauline Gower of Great Britain, Helen Harrison of Canada, Valentia Grizodubova of Russia, Lois Coots Tonkin, meteorologist of the U. S. Weather Bureau, and many others, aircraft designers, flight nurses, military instructors, aeronautical engineers, and editors. In this book Sally Knapp not only reveals opportunities for women but by her gift of story telling reveals the caliber of women needed in the sphere of aviation. —G. O.

WOOD, MARTHA. *Heroes of the Air.* New York: Thomas Y. Crowell, 1946. 484 p. $2.50.

Here is the dynamic story of aviation from the past to the present, a chronology of flight from 1782–1945, an exciting chronicle of some of the most daring exploits of aviation with the pioneers of flight, Montgolfier, deRozier, the Wright brothers, and other winged souls; in 1924, the first flight around the world; in 1927, Lindbergh; then Amy Johnson. The '30's are revealed as great milestones of flight. China clippers came in 1936, and "Wrong Way Corrigan" in 1938 and Ellsworth in 1939. Then came the war years and the skies are filled with winged warriors. *Heroes of the Air* is the one complete book of flying heroes.

—G. O.

BOLTON, SARAH K. *Famous Men of Science.* New York: Thomas Y. Crowell, 1946. 308 p. $2.50.

This is a collection of biographies of some of the world's outstanding scientists, including some living today. What they gave to the world is told in a warm, anecdotal style; and the author reveals these men of science as warm, lovable human beings. The list is varied and includes naturalists, astronomers, physicists, and chemists. School libraries will welcome such a book of biography and the layman who likes biography will find this book good reading.

—G. O.

MERSEREAU, SAMUEL FOSTER, REEN, CALVIN G., AND HOLDERNMAN, KENNETH L. *Materials of Industry.* New York: McGraw-Hill Book Company, 1947. 623 p. $2.80.

This is the fourth edition of a book first published in 1931. Intended as a text in a systematic course on the common materials of industry in technical, industrial, or vocational high schools; the book is an unusually fine reference for students and teachers in chemistry, biology, geography, and physical science survey courses. Teaching aids such as motion pictures and filmstrips, maps, charts, demonstrations, specimens are included. Most of the common industries are covered: forest products, nonmetallic minerals, non-ferrous metals, iron and steel, rubber, plastics, paints, and so on.

—R. J. A.

BARTON, WILLIAM H., AND JOSEPH, JOSEPH MARON. *Starcraft.* New York: Whittlesey House, McGraw-Hill Book Company, 1946. 250 p. $2.75.

This is the second edition of a book first published in 1938. The first edition merited the popular success it attained because few, if any, better popular amateur books in astronomy have ever been published. As in the older edition, mathematical and scientific terminology is kept to the very minimum. The revised edition includes up-to-date and several new charts and photographs.

Starcraft describes the solar system, meteors, how distances to stars are measured, how to identify the various constellations and individual stars, how to make a telescope and other astronomical devices. Untrained persons by following the directions and using the star charts included can easly become as familiar with the stars and constellations as with their neighborhood. Interesting information is included about the constellations and the stars. Several excellent photographs are included.

General science teachers, elementary science teachers, science clubs, boy and girl scouts, and any layman interested in knowing the heavens will find this about the finest book they are likely to run across. —R. J. A.

HAMILTON, LEICESTER F., AND SIMPSON, STEPHEN G. *Calculations of Analytical Chemistry.* New York: McGraw-Hill Book Company, 1947. 387 p. $3.50.

This fourth edition has been expanded to cover the stochiometry of both qualitative and quantitative analysis. The greater part of the book is still devoted to the calculations of quantitative analysis. There are 1,032 problems.

—R. J. A.

LEACH, W. JAMES. *Functional Anatomy of the Mammal.* New York: McGraw-Hill Book Company, 1946. 231 p. $2.50.

This is a well-illustrated guide to the dissection of the cat with an introduction to the structural and functional relationship between the cat and man. The directions are simply given and the guide should readily serve the needs of beginners in anatomy.

—S. M. A.

COLIN, EDWARD C. *Elements of Genetics.* Philadelphia: The Blakiston Company, 1946. 402 p. $3.50.

This is a revision of a very popular text first published in 1941. New and clarifying material has been added, and much of the older material has been revised. An excellent text, the reviewer has always found it to be one of the finest references on heredity. It is recommended for such purposes to general science and biology teachers.

—S. M. A.

STILES, KARL A. *Handbook of Microscopic Characteristics of Tissues and Organs.* Philadelphia: The Blakiston Company, 1946. 214 p. $1.75.

This handbook outlines the subject-matter of histology giving clear, concise and reasonably complete descriptive definitions of all body tissues. For most tissue systems there are tables listing classifications and histologic summaries that are systematically arranged and clear. Diagrams of the different types of epithelial and connective tissues are especially well presented.

Blank pages are provided in every chapter for the student to add diagrams and drawings on all tissue systems, so that this handbook may supplement a laboratory manual. This provision seems to entitle the term handbook rather than syllabus, synopsis, or abstract.

For a comprehensive concept of a scientific subject, the use of, or preparation of, an outline of the subject is helpful in the course of study and especially so for review. This handbook serves a definite usefulness in demonstrating how to make a good, systematized and complete outline of the subject matter in histology. While 100 of the listed 214 pages are blank for student use, there are in addition to the definitions, classifications, summaries and diagrams, a useful glossary of 250 terms and an index with more than 500 listings.

—R. D.K.

MERIDITH, FLORENCE L. *Hygiene*— A Textbook for College Students on Physical and Mental Health from Personal and Public Aspects. Philadelphia: The Blakiston Company, 1946. 838 p. $4.00.

This is an excellent book emphasizing the all-important problems of personal and public health with particular stress on the function of every person to understand, and be responsible for, his own healthful living, and thus promote the health of the community at large. It represents functional education for everyday living rather than traditional and scholastic education handed down from the past.

The nine major sections are concerned with (1) the health situation in the United States; (2) the body in health and disease; (3) forces for health; (4) the problem of infections; (5) other major health problems; (6) accidents and poisoning; (7) the hygiene of everyday life; (8) reproduction; and (9) mental health. There is scarcely any health problem which doesn't receive mention and discussion. The expressed plan of the book is to focus attention on health situations in the lives of individuals or social groups; "what health objectives arise from them;" and "what action is scientifically appropriate on the part of the layman." What a contrast to the usual courses in zoology, botany, or general biology commonly required of college freshmen!

Grouped under the nine major sections are fifty-seven chapters discussing the more detailed problems of health. Each chapter has a functional title. For example, Part II—really borrowed from anatomy and physiology in health and disease—has three chapters: (1) the general plan of the body; (2) the systematic work of the body; and (3) disease and recovery. Part III, under forces for health, has seven chapters; (1) beginnigs of medical science; (2) medical science today; (3) using medical service; (4) avoiding cults and quackery; (5) beginnings of public health work; (6) public health work today; and (7) personal preventive medicine. Notable chapters are those on reproduction, heredity, parenthood, the self impulse, the sex impulse, the social impulse, medicines and self-medication, alcohol and other habit-forming drugs. Every chapter treats of a definite and functional phase of everyday living—physical, psychological, or social.

One cannot help but think that, with more of this sort of instruction in public schools and colleges, the higher the levels of personal and public health would become. While a good many technical terms are used in the book, they are relatively few in number and explained so that the student may understand.

The supplement includes tables of food values, calorie-content, national health organizations, and a bibliography for each of the nine major sections mentioned before.

A. W. H.

MCCANCE, R. A., AND WIDDOWSON, E. M. *The Chemical Composition of Foods.* Brooklyn: Chemical Publishing Company, 1947. 156 p. $3.75.

In a quantitative study of dietetics and nutrition it is essential to have a thorough knowl-

edge of the chemical composition of foods. This book supplies such data in two sets of tables, one listing the composition per 100 grams, the other per ounce. To those associated with food industries, dieticians, physicians, food and research chemists, this book should be of value. Over 541 varieties of food are analyzed. —G. O.

BENNETT, H. *Concise Chemical and Technical Dictionary.* Brooklyn: Chemical Publishing Company, 1947. 1055 p. $10.00.

Here is an up-to-date chemical and technical dictionary where every effort has been made to obtain accurate and authoritative information on each entry concerning terms in chemistry, metallurgy, pharmacy, plastics, physics, mineralogy, electricity, engineering, and trade-made products—50,000 definitions. Each entry is printed in boldface type in a compact paragraph easy to locate on the page. The dictionary is durably and attractively bound, a fund of information for the layman as well as for the business executive and salesman, student, chemist, and chemical engineer.

—G. O.

CHATFIELD, H. W., AND WREDDEN, J. H. *Varnished Cloths for Electrical Insulation.* Brooklyn: Chemical Publishing Company, 1947. 255 p. $6.00.

In this book the authors have collected information which was formerly scattered throughout technical and trade literature whose study merits special attention because varnish insulating fabrics are exacting but adaptable materials and call for scientific knowledge and applied technical skill in their manufacture and in their use as components of electrical assemblies. The book tells the textile manufacturer what he needs to know about the processing of such materials; the varnish maker something of the textiles on which his varnish may be applied, and finally the electrical engineer and designer something of a material which he is using in ever-increasing amounts.

—G. O.

SOMMERS, A. *Photoelectric Cells.* Brooklyn: Chemical Publishing Company, 1947. 104 p. $2.75.

The industrial uses of photoelectric cells are very numerous. Photometry, sound film reproduction, picture telegraphy and television are a few of the important uses. This book describes the composition of different types of photoelectric cells, operating efficiency, uses and so on.

—G. B. K.

BENNETT, H. *Chemical Specialties.* Brooklyn: Chemical Publishing Company, 1946. 826 p. $12.50.

Chemical Specialties is a symposium covering every aspect of the chemical specialty business Hundreds of formulae are given for the manufacture of cosmetics, inks, food-stuffs, adhesives, textile finishing agents, toilet articles, and so on. Directions are given in simple and clear language. Sources of raw materials and equipment are listed. Methods of testing and storing raw materials, packing and shipping the finished products are described.

This is an excellent reference for the chemistry teacher and the chemistry book-shelf.

—G. B. K.

STRONG, JOHN H. *Fabric Structure.* Brooklyn: Chemical Publishing Company, 1947. 241 p. $6.00.

Based on the author's nearly fifty years of experience in textiles, the book discusses not only the finished products and their method of manufacture, but also the various threads used in weaving, explaining their characteristics, requirements, testing, and treatment. More than 400 illustrations supplement the textual material.

—G. B. K.

BLUMENTHAL, SAUL. *Food Products.* Brooklyn: Chemical Publishing Company, 1947. 986 p. $12.00.

This is a comprehensive treatise on food products. Based on the author's own experience of many years and that of other specialists in the field, there are practical, factory-tested formulas for making hundreds of commercial food products in the canning, flavoring, beverage, confectionery, essence, condiment, dairy, meat, fish, and allied industries. There are special chapters on dehydration, freezing, foodplant sanitation, and the composition of foods.

There is a wealth of information on popular and basic food ingredients. This is not only a fine reference for the food manufacturer, but also for home economics and consumer science courses. —C. L. D.

HAUSNER, HENRY H. *Powder Metallurgy.* Brooklyn: Chemical Publishing Company, 1947. 298 p. $7.00.

The principles of powder metallurgy are explained in the form of tables and graphs. The methods of manufacturing metal powders, and the commercially available metal powders, and their applications are fully described in the book. Over 120 tables and graphs help to make this one of the most thorough treatises in the field. There is a chronological bibliography of 1064 titles.

—C. L. D.

HILL, D. W. *Science—Its Effect on Industry, Politics, War, Education, Religion and Leadership.* New York: Chemical Publishing Company, Inc., 1946. 114 p. $2.75.

In keeping with the policies of the Chemical Publishing Company and in keeping with the line of authors stemming from E. E. Slosson to

bring science to the people, we have this concise little contribution. The text is made very readable by pointed chapter headings, an introductory master quotation, and a very direct attack upon the matter in hand.

Mr. Hill makes no pretense to originality or to really new ideas—he merely with modesty and efficiency complies ideas gleaned from a rich experience and careful readings. He is very fortunate in his choice of ideas and their organization and presentation. He also happily states in very few words what others less capable would require a large volume to present.

The reviewer would make this a "must" for the young teacher, especially of science, the school superintendent, the busy educated layman, the preacher, and the politician. Fortunately this message to the industrialist is rapidly being learned from his own hard experience. Particularly commendable are his chapters on what science as an attitude and a method should mean to general education, and as essential to any liberal education. We learn science too much for its utilitarian rather than for its wider, deeper, cultural values, thinks Mr. Hill.

—F. A. R.

BAKER, ROBERT H. *Introduction to Astronomy.* New York: D. Van Nostrand Company, Inc., 1947. 229 p. $3.00.

This is the third edition of a book first published in 1935. Previous training in Physics and mathematics is not assumed. However, the material is authoritative and up-to-date. The book will serve admirably as a beginning text in astronomy, as a text or reference for the astronomy phase of the physical science survey course, and as excellent reference for the secondary science teacher and the elementary science teacher.

—C. M. P.

BROWN, GEORGE H., HOYLER, CYRIL N., AND BIERWIRTH, RUDOLPH A. *Theory and Application of Radio-Frequency Heating.* New York: D. Van Nostrand Company, 1947. 370 p. $6.50.

Radio-frequency heating is rapidly becoming a science. This book explains its underlying principles. The work is quite mathematical and technical. Radio-frequency heating offers every promise of being much more common in the future.

—G. B. K.

AREY, LESLIE BRAINERD. *Developmental Anatomy: A Textbook and Laboratory Manual of Embryology.* Philadelphia: W. B. Saunders Company, 1946. 616 p. $7.00.

The new edition consists of rewriting with a new organization of Part I, corrections bringing Parts II and III up-to-date, and many new illustrations. Bibliographies at the end of each chapter are "citations [which] direct attention to newer or controversial interpretations."

Readers are told, "Unless the context clearly implies the contrary, [you] may assume that the unfolding of the developmental story in this book is an account of [your] own formative course."

College biology departments need no introduction to this standard work. The section on "Ancestral Repetitions" and the emphasis on human development make it a most valuable reference for teachers in the upper grades and high school science courses.

—M. E. O.

BOGERT, L. JEAN. *Fundamentals of Chemistry.* Philadelphia: W. B. Saunders Company, 1946. 571 p. $3.00.

This is the sixth edition of a book that has had extensive use in classes for nurses, public health, nutrition, and home economics. More emphasis has been placed upon the biological and physiological implications of chemistry. War time advances and discoveries have been taken into consideration in the new revision. Physical science survey, biological science survey, and high school chemistry classes will find this a good reference text.

—G. B. K.

BOGERT, L. JEAN. *Laboratory Manual of Chemistry.* Philadelphia: W. B. Saunders Company, 1946. 196 p. $1.00.

This is a loose-leaf manual to accompany the textbook reviewed above (Fundamentals of Chemistry). A total of 130 experiments are included.

—G. B. K.

HOPKINS, B. SMITH, MOELLER, THERALD, AND SCHIRMER, FRANK B. JR. *Laboratory and Classroom Exercises in General Chemistry.* Boston: D. C. Heath and Company, 1946. 244 p.

This is a first-year college Chemistry laboratory based on "experience in the laboratory." Directions should be easily followed.

—S. M. A.

EDDY, SAMUEL, OLIVER, CLARENCE P., AND TURNER, JOHN P. *Guide to the Study of the Anatomy of the Shark Necturus, and the Cat. Atlas of Outline Drawings for Vertebrate Anatomy.* New York: John Wiley and Sons, Inc., 1947. 115 p. $2.00.

The first is a loose-leaf guide for dissecting animals in a source in comparative vertebrate anatomy. The second is a series of 102 outline drawings which the student can label and study with a minimum of time spent in laborious drawings.

—R. J. A.

STRAUSBAUGH, PERRY D., AND WEIMER, BERNAL R. *General Biology.* New York: John Wiley and Sons, Inc., 1947. 718 p. $4.75.

Many changes have been made in this second edition. The last chapter of the first edition, rewritten and enlarged, has become the first

chapter of this edition. More stress is placed on principles and the importance of the scientific method. A new chapter on hormones has been added. Altogether this text seems to be a very good college text in beginning biology. Secondary biology teachers will find it an excellent reference. —G. E. D.

ADAMSTONE, F. B., AND SHUMWAY, WALDO. *A Laboratory Manual of Vertebrate Embryology.* New York: John Wiley and Sons, Inc., 1947. 96 p. $2.00.

This is a loose-leaf manual including directions for the anatomy of selected embryos of the frog, chick, and pig. —R. J. A.

MICHENER, WILLIAM H. *Physics for the Students of Science and Engineering.* New York: John Wiley and Sons, Inc., 1947. 646 p. $4.25.

The author believes that too many students of physics are prone to memorize words, formulas, and procedures by means of which they can pass examinations. In this book he attempts "to present the subject in such a way that the student will be encouraged to think for himself." Fundamental principles are stressed. There is a minimum number of formulas. Intended for sophomore engineering students, the order of contents is: mechanics, heat, wave motion and sound, light, electricity and magnetism.

—C. L. D.

ELDRIDGE, JOHN A. *College Physics.* New York: John Wiley and Sons, Inc., 1947. 720 p. $4.50.

This is the third edition of a textbook written to appeal to the student with a general interest in physics—the non-science major. At the same time there is sufficient material to give a solid foundation for the student with a direct professional interest in physics. The book has been written with the major idea that physics can be made interesting and useful for every student. Even with this most laudable ideal, it probably remains true that its attainment depends primarily on the teacher teaching it. The subject matter is that which is common to most beginning courses in college physics.

—C. M. P.

FLINT, RICHARD FOSTER. *Glacial Geology and the Pleistocene Epoch.* New York: John Wiley and Sons, Inc., 1947. 589 p. $6.00.

The Pleistocene epoch occupies a peculiarly important place in the time scale of geology, embracing as it does the events of the latest million or more years of the earth's history. The book gives a compact reconstruction of the history of the Glacial epoch valuable for geologists, geographers, ecologists, physical science survey teachers, and others interested in this prehistoric realm.

The twenty-three chapters present in detail the characteristics of glaciated regions, glacial deposits, the extent of world glaciation, the various glacial periods, and the possible causes. There are 88 illustrations, and 6 plates.

There were at least four glacial and three interglacial stages in North America. The author discusses the various hypotheses of the causes of the various glacial periods, and points out the fatal weakness of each theory. Then he assimulates the data for the solar-topographic hypothesis which assumes (1) the fluctuation of solar radiation as the cause of world-wide temperate changes, and (2) the presence of highlands as the prime factor determining the accumulation of snow and the distribution of glaciers. The topographic aspect seems well established on firm geologic evidence. The solar aspect is consistent with the stratigraphic evidence, but naturally the observational evidence of solar variation is limited.

—C. M. P.

EHRET, WILLIAM F. *Smith's College Chemistry.* New York: D. Appleton-Century Company, 1946. 677 p. $4.25.

This is the sixth edition of one of America's best known college textbooks. The three preceding editions were edited by James Kendall. The first edition was published in 1905 by the late Alexander Smith.

Some chapters have been entirely rewritten, others partially, and the arrangement of chapters somewhat altered. Few books offer a more comprehensive treatment. However, those desiring a less comprehensive course can readily omit material without much, if any, loss in continuity. A list of exercises and reading references are found at the end of each chapter.

—S. M. A.

JORDANOFF, ASSEN. *Dials and Flights.* New York: Harper and Brothers, 1947. 358 p. $5.00.

This is an up-to-the-minute discussion of aviation instruments by a world-famous authority in aviation. Author of numerous articles in newspapers, magazines and technical publications, he has also published *Your Wings, Safety in Flight, Flying and How to Do It, The Man Behind the Flight, Illustrated Aviation Dictionary, Through the Overcast,* and *Power and Flight.* The book is profusely illustrated with seventy-two full page half-tones and two hundred line drawings, diagrams, and charts.

—S. M. A.

NYBERG, JOSEPH A. *Fundamentals of Solid Geometry.* New York: American Book Company, 1947. 267 p. $1.72.

Emphasizing practical problems, the fundamentals of solid geometry are presented around 48 basic theorems.

—G. B. K.

PETERSON, THURMAN S. *College Algebra.* New York: Harper and Brothers, 1947. 334 p. $2.50.

This is a text for college students who have at least one year of secondary school algebra. —G. B. K.

GRIFFITHS, LOIS WILFRED. *Introduction to the Theory of Equations.* New York: John Wiley and Sons, Inc., 1947. 278 p. $3.50.

This is a thorough presentation of proofs of the important general theorems in the elementary theory of algebraic equations. —G. B. K.

CORNOG, JACOB. *Semimicro Experiments in General Chemistry.* Boston: Ginn and Company, 1947. 217 p. $2.20.

Experiments in this manual require only one-fifth to one-tenth the quantity of chemicals used in macro experiments. The apparatus used weighs and costs only half as much. Less storage space is thus required for the whole set up. Much emphasis is laid on quantitative experiments. —C. M. P.

LEWIS, SIR THOMAS. *Exercises in Human Physiology.* New York: The Macmillan Company, 1945. 103 p. $1.25.

This handbook is "preparatory to clinical work." The author states, "For many years I have held the view that the transition from preclinical to clinical studies is the most difficult period through which medical students have to pass. It is difficult because it is a change from the deliberate and scientific ways of academic study to those of hospital life, governed as this constantly is by the urge to succour sick people. . . . The desirable bridge has seemed to me to be the bridge of human physiology."

Exercises deal with blood pressure, effects of exercise, reflex effects of heat and cold, goose skin, cutaneous sensation, referred pain, effects of drugs, etc. Directions are concise and readily understood. Many require very little apparatus. A number of them could be used in more general biology courses. As a reference in the latter courses, this book will be valuable as a source for enrichment. —M. E. O.

WHITE, M. J. D. *Animal Cytology and Evolution.* New York: The Macmillan Company, 1945. 375 p. $7.50.

Biologists have been indebted for better than two decades to the monumental work by E. B. Wilson, *The Cell in Development and Heredity.* The above volume is perhaps a successor, although of narrower scope.

Cytologists and geneticists, as a matter of course, recognize the value of this cyclopedic summary by White; biology teachers, too, will find it invaluable. The author characterizes it (p. 303) as, "a survey of existing knowledge about the changes which the chromosomes have undergone in the evolution of the Metazoa."

The general statement as to the present-day concepts of the nature of the evolutionary process; the structure of chromosomes, especially as revealed by the study of the salivary-gland chromosomes (in *Drosophila* and other Diptera); the relation between structural rearrangements (of chomosomes) and closely related species; the causes of hybrid sterility; the evolution of meiosis and of the sex-determining mechanism; etc.—make this volume a storehouse of up-to-date knowledge for biology instruction.

One is impressed by the vastness of the fields as yet unexplored. As White states, [our] "knowledge is fragmentary and incomplete in almost every respect, but it at least shows that the physical basis of evolution has itself undergone an evolution of its own, and is, in fact, still evolving. In the past it has been customary to explain the 'paterns' of evolution as largely or entirely determined by environmental factors. . . . Much less attention has been paid to the inherent properties and potentialities of particular genetic systems considered as limiting factors in evolution. No doubt all evolutionary 'paterns' are the result of interaction between environmental factors and genetic systems (rather than between the environment and *single* genes); we really know very little about this kind of interaction, although it is the very kernel of the whole evolutionary problem." The "little" at least consists of many pieces and also fits into a consistent orderliness which presages further discoveries.

The biology classroom with this volume available for reference will indeed be fortunate. —M. E. O.

HOUGH, ROMEYN B. *Handbook of the Trees of the Northern States and Canada.* New York: The Macmillan Company, 1947. 470 p. $5.50.

This is a reprint of one of the finest and most delightful handbooks on trees that has ever been published. The book is illustrated by 479 informative photographs. The illustration includes a photograph of the tree itself, its leaves, its fruits or berries, bark, leaves, flower, fruit, and so on. An analytical key for classification is found in the back of the book.

This is an excellent book for the high school biology and general science teacher, the elementary science teacher, and any other person interested in learning more about the trees of his environment and how to recognize them. —G. E. D.

WINLOCK, H. E. *The Rise and Fall of the Middle Kingdom of Thebes.* New York: The Macmillan Company, 1947. 174 p. $5.00.

An outstanding archaeologist and scholar who spent twenty-one years excavating and exploring in Thebes presents his findings and conclusions of an important period of ancient Egypt—the period of the Eleventh through the Sixteenth

Dynasties, from 2134 to 1476 B.C. It depicts vividly what an archaeologist does and how he interprets the results of his research. Forty-eight plates supplement the textual material.

—G. E. D.

SELF, MARGARET CABELL. *The Horseman's Encyclopedia.* New York: A. S. Barnes and Company, 1946. 519 p. $5.00.

This is one of a series of factual, authoritative volumes in *The Sportman's Library* series. *The Horseman's Encyclopedia* is an original compilation of all that is known about the horse from the days of Paleolithic man down to the present. The author, a native of the hunting country of Virginia, has written a number of fine books about horses. She has a riding school of her own in Connecticut and gives professional instruction.

A year of a horse's life is equivalent to three of a man's. Horses have been known to live beyond the age of forty, and there is supposedly an official record of an English horse that lived to be 55, and an unofficial record of a horse living to be 72! (Man-of-War is now 30).

—R. J. A.

HEADQUARTERS STAFF OF THE AMERICAN RADIO RELAY LEAGUE. *The Radio Amateur's Handbook.* West Hartford, Connecticut: The American Radio Relay League, 1947. 169 p. plus 159 p. $1.25.

This is the twenty-fourth edition of America's best-known radio guide. It is designed and written as an amateur radio communications manual. The accent is on practical utility and a down-to-earth constructional approach. There are three main sections (with numerous diagrams and illustrations—a total of 1257): Principles and Design, Equipment Construction, and General.

—R. J. A.

LEMON, HARVEY BRUCE. *From Galileo to the Nuclear Age.* Chicago: The University of Chicago Press, 1946. 451 p. $5.00.

Twelve years have elapsed since the publication of *From Galileo to Cosmic Rays.* Since that time much has happened in the world and for this, Physics is responsible for an unduly large amount. Whether or not the advances in Physics are, in large measure, for good or for evil still remains undetermined. Nor is it likely that the final appraisal can be written in this generation.

Certainly the coming of the nuclear age has tremendously increased the importance of Physics—at least in the eyes of the layman. *From Galileo to Cosmic Rays* was an attempt to write a new type of textbook that would appeal to the non-major in Physics. Wide usage attests to the fact that this attempt was appreciated and welcomed by many students and college teachers. Even today the book is a *different* physics textbook, unlike any other. Many students who would have found most college physics texts "out of this world" in so far as they themselves were concerned, have found this book surprisingly delightful study. This edition brings the material up to date with its treatment on nuclear discoveries. This new edition is most likely to become even more popular than its predecessor.

—C. M. P.

HUXLEY, JULIAN. *Unesco: Its Purpose and Its Philosophy.* Washington: Public Affairs Press, 1947. 62 p. $1.00.

The author, a well known scientist and educator, is Director General of the United Nations Educational Scientific and Cultural Organization as well as Executive Secretary of the Preparatory Commission of UNESCO. This agency was created "to contribute to peace and security by promoting colloboration among the nations through education, science, and culture."

The first chapter presents the background of UNESCO: its aims, philosophy, and general principles. The second chapter presents the program of action for UNESCO.

Altogether this treatise is the finest, most understandable statement that he has read about UNESCO.

—C. M. P.

Hammond's Comparative World Atlas. New York: C. S. Hammond and Company, 1947. 50 p. $0.50.

This is a compilation from the company's publications, giving precise geographical information. It gives the latest reliable data in its maps. The world maps cover such topics as religions, languages, climates, and natural vegetation. Other maps cover physical conditions and populations. There are winter and summer temperatures and rainfalls for world areas, also charts showing products of mines, agriculture, and fisheries. The large pages, 8" x 10", give valuable information geographically shown.

—W. G. W.

TYLER, KINGDON S. *Telecasting in Color.* New York: Harcourt, Bruce and Company, 1946. 213 p. $2.75.

Telecasting in Color presents the basic principles of television. Each step of a program from its inception in the studio to its appearance on the television receivers is explained in simple language. Microphone, radio tubes, transmitters, antennas, and receivers are discussed in detail, as well as the latest type of television camera and receiver tubes.

Black and white television, color television, and a new system called *pulse time modulation* (which is a method of transmitting sound and picture together) are described. Telecasting in color has been less difficult than the original black and white television. Colored television, in a developmental stage for 18 or 20 years has now progressed to the high quality colored pictures equal to or better than 16 mm colored movies. It is now commercially sound. Television stations now must be within line sight of the transmitting station, normally about 60 miles

around New York City. However there is an operating relay station near Schenectady that is 129 air miles from New York.

Television will quite probably soon become a part of our daily lives just as the telephone, automobile, airplane and radio have.

—S. M. A.

ARMSTRONG, E. F., AND MIALL, L. M. *Raw Materials from the Sea.* Brooklyn: Chemical Publishing Company. 1946. 196 p. $3.75.

The ocean is a rich source of mineral resources. Some of these minerals exist in relatively large amounts, others in traces. The winning of these inorganic salts is a question of economics, preference being given to the cheapest source. Often a new process makes it economical to work natural resources previously neglected.

This book discusses the various chemical problems which the oceans represent and the substances present in them.

The oceans cover 61 per cent of the northern and 81 per cent of the southern hemisphere. The mean depth is approximately 2.2 miles. The Atlantic Ocean covers 25,000,000 square miles; the Antarctic—30,000,000; the Arctic, 8,400; the Pacific, 50,000,000; the Mediterranean, 1,006,600; the Caspian Sea, 160,000; the Black Sea, 950,000; the Baltic, 175,000. Including all inland bays and seas, the oceans comprise 147,800,000 square miles with a volume of about 300 million cubic miles.

Bromine ranks about twenty-fifth among the elements of the earth's crust (.001 per cent) and 91 per cent of this occurs in the sea. Production in the U. S. in 1942 was nearly 66 million pounds. In many countries the ocean is the chief source of common salt, e.g. China, Japan, India, Siam, Somaliland, and so on. Much magnesium is now being recovered from the sea as is also much of the world's iodine supply.

—R. J. A.

LEGGETT, WILLIAM F. *The Story of Wool.* Brooklyn: Chemical Publishing Company, Inc., 1947. 304 p. $5.00.

We can envision a remote ancestor, in the forest age, who about one million years ago roamed from India to Gilbralter. He was about five and one-half feet high, having a short thick trunk which was carried far from erect, because he usually preferred to travel on all fours, resting his weight on his knuckles. He was capable of changing and modifying his environment—at first wearing a skin garment and later discovered that the fleecy undercoat of sheep could be converted into warm clothing. Nature found it impossible to keep man static, for evolution is a restless mistress, ever searching for the best. The peoples of southern Asia and northern Africa herded sheep. It was the Moors, Berbers and Saracens, invading tribes-men who conquered Christian Spain, who learned of methods to lighten the color of fleece. The Arabs learned that sheep fed on rich grasslands usually produced white wool. This was one reason why the Hebrew shepherds ceaselessly roamed the "fertile crescent" in search of fresh grazing land. Thus by moving from one feeding ground to the next a fairly highly developed type of sheep which had historical origins in Asia was introduced into Spain.

Spain had a monopoly on the wool industry (from Merino sheep) for a long time and had strict laws prohibiting exportation of Merino sheep from Spain. European cloth merchants were forced to pay any price for wool that the Spanish wool dealers demanded. During the 18th century various European countries succeeded in smuggling or otherwise contrived to obtain Spanish-bred Merino sheep and, often with excellent results, cross-bred them with native types. From this source came the Rambouillet sheep of France and the Silesian sheep of Saxony, both famous for their fleece. At the time of the Spanish Armada of 1588, several Spanish vessels were wrecked on the coast of England, and many Spanish sheep, carried by the fleet for food, succeeded in swimming ashore. They reached grazing grounds in the Chevoit Hills, where, because of their fine wool, they have been bred ever since.

Wool production and manufacture, in England, America, Australia, Peru and other parts of the world are presented from a historical and economic viewpoint. Animal fibers are obtained from the sheep, goat, camel, llama, guanaco, vicuna and alpaca, and each of these are discussed.

George Washington did much to promote wool production and manufacture in the United States and in 1789 wore a fine wool suit at his inauguration, made in a mill which was the first its size to use water power in woolen manufacture. The suit was described as "a fine, dark brown woolen coat, waistcoat and breeches, which were worn with white silk stockings and shoes with silver buckles."

Origin of the names of woolen fabrics such as serge, gabardine, tweed, worsted, broadcloth and others are given in the back of the book. There is a two page bibliography.

Students and teachers in the field of Economic Geography will be interested in the nomadic herders and how they make their tents,—as to the covering used and the wool that is used for the frame work.

Here is a book which will be of great interest to students, chemists, chemistry teachers, textile technicians, and engineers, as well as all workers in the various branches of the textile industry. It would be of interest to students and teachers in the field of Home Economics in the study of Textiles.

—F. M. D.

ROBERTS, HENRY C. *The Complete Prophecies of Nostradamus.* New York: Crown Publishers. 1947. 350 p. $3.00.

This famous book of "prophecies" presents a peculiar challenge to the scientist-reviewer.

Natural science being dedicated to the orderly presentation of tested knowledge and opposed to magic, mystery and unusual human "powers," can speak only with a pronounced bias here.

Nostradamus dates his original works in mediaevel French, with Latin comments, in 1555. Roberts presents the writer as a deep-seeing mystic who writes his occasional revelations of things to-be in obscured poetic quatrains. The text is divided into "Centuries." Roberts provides a very free translation of the meanings he reads into the verse. Occasionally he greatly strains the original, in our opinion.

A satisfactory evaluation would involve much quotation and indeed much checking against authoritative subsequent history. But briefly, it may be stated as our personal opinion that the text shows: (1) Prophecies, if such they are, are stated obscurely even to the point where Roberts himself has to admit his and Nostradamus' inability to reach a conclusion, (2) The prophecies are often far out of chronological order, (3) No practical use can be made of the work as a whole, for many "prophecies" could be applied with equal validity to many possible events or possibly appropriate situations. Other "prophecies" seem a mere mumbo-jumbo of words, not even intended as prophecy but rather just whims or fanciful juxta-position of words.

In all fairness, there are here and there what might be considered prophecy, but such even could possibly be coincidences except in the very few instances where names, places, and dates are most positively suggested.

We recommend it to the reader who is imaginative, with time to spare, a voluminous history at his side, and not too much bent on scientific objectivity.

In this world so full of surprises, so many possibilities, these may be prophecies indeed, but the reviewer for the most part fails to be impressed. —F. A. R.

LIEBER, LILLIAN R., AND LIEBER, HUGH GRAY. *Take a Number.* Lancaster: The Jaques Cattell Press. 1946. 221 p. $2.75.

Take a Number is subtitled *Mathematics for the Two Billion.* The book is written in an engaging and enlightening style which at once sets it apart from the usual mathematics book—even the popular ones. Clever drawings help to describe the fundamentals and practical uses of mathematics. Through a few basic rules of the game the reader is led to preform the basic operations and is given enough practice to acquire considerable skill. —G. B. K.

BALL, W. W. ROUSE. *Mathematical Recreations and Essays.* New York: The Macmillan Company, 1947. 418 p. $2.95.

This is a revision by H. S. M. Coxeter of probably the most popular book of its kind that has ever been published. This is the eleventh edition since first publication in 1892. In this book you will learn about magic squares, about ferry boat problems, about mazes, labyrinths, map-coloring problems, mathematical card tricks, Kirlsman's famous School Girls Problem, calculating prodigies, cryptography and cryptanalysis, and numerous puzzles. In brief this is a book that will delight the mathematics teacher, the student and laymen who delight in mathematics as a recreation and a hobby. Many of the problems and puzzles require a minimum of mathematical skill but quite often require much thinking. —G. B. K.

NEELETTE, C. B. *Careers in Photography.* Chicago: Ziff-Davis Publishing Company, 1946. 182 p. $2.50.

Careers in Photography is by one of America's best known writers in the field of photography. He is now Head of the Department of Photographic Technology, Rochester Institute of Technology. This book is most timely, coming as it does, at a time when so many veterans are enrolled in college, and are still undecided as to a vocation. Many of them, having had some war experience in photography, will decide upon some phase of photography. This book should be most helpful to such persons (and any others interested in this possible vocation) as it covers practically every type of photographic work. High school counselors and advisers will find this an excellent reference.

Included are such aspects of photography as: portrait, commercial and industrial, advertising, motion picture, press, legal, aerial, astronomy, and spectroscopy, medical, natural history, high speed, photo copying, radiography, photomicrography, etc. There are chapters on teaching, writing and editing photography, travel photography, preparation for a career, and desirable aptitudes for success in photography.

—C. M. P.

PALME, ARTHUR. *Speedlights.* Boston: American Photographic Publishing Company, 1946. 128 p. $2.50.

Speedlights describes the newest photographic technique in high speed photography. Developed because of necessity (the allotment of practically all photo-flash bulbs to the armed forces), the many commercial sets are described, and diagrams and directions are given for building your own. Speedlights can be used continuously. They have many practical uses and advantages over photoflash bulbs. Numerous photographs supplement the textual material.

—C. M. P.

HAMMOND, ARTHUR. *Pictorial Composition in Photography.* Boston: American Photographic Publishing Company, 1946. 155 p. $3.50.

This is the fourth edition of a book first published in 1920. The author is one of America's best known authorities in photography. He is associate editor of *American Photog-*

raphy. He knows all of the angles and pitfalls from a photographer's point of view; not only is the theory of composition given, but its practical application to photography is discussed in detail. The book ends with a chapter on various methods of pictorial printing, toning, and finishing.

Forty-eight illustrations of the author's work as well as that of other eminent photographers are shown and discussed in detail.

—C. M. P.

HAMMOND, ARTHUR. *How to Tone Prints*. Boston: American Photographic Publishing Company, 1946. 76 p. $2.00.

This is a rather comprehensive treatise on tone prints. There are chapters on *The Fundamental; Sepia Toning;* Gold, Selenium, Copper, and Ceranium Toning; and Blue, Green, and other Toning Data. Many formulae are given.

—C. M. P.

MCGARRETT, VINCENT. *Toward Better Photography*. Boston: American Photographic Publishing Company, 1947. 260 p. $3.00.

Toward Better Photography presupposes some experience in photography, and aims to correct the common errors into which so many amateurs gravitate. Proper standards are set up with details on how to meet these standards.

If you have that disconcerting feeling that you are not as expert as you ought to be in view of the amount of work you have done, here is a refresher course to shake off your bad habits, and see how good you can be.

There are chapters on: Meet Your Camera, Selecting a Camera, Exposure, Photographic Lighting, The Darkroom, Negative Development, Contact Printing, Projection Printing, After-Treatment of Negatives and Prints, Monochromatic Rendering of a Color, Color Films, Home Movies, Trouble Shooting, At Work with your Camera, and Good Composition.

—C. M. P.

MCMILLEN, WHEELER. *New Riches from the Soil*. New York: D. Van Nostrand Company, 1946. 397 p. $3.00.

The subtitle of this book is "The Progress of Chemurgy." Chemurgy is an idea rather than a science. It has to do with the industrial utilization of plant raw materials. A national chemurgic convention was recently held in Oklahoma City and the emphasis at this meeting was on the desirability and possibility of chemurgy serving as the basis for a new industrial and economic security for the farmers. Present surpluses must soon find a new outlet.

This is the story of how Chemurgy began and how it is influencing the lives of many through new products, new jobs, and better sales for the farmer.

As one reads this book he is amazed at the number and kinds of new plants that have been introduced into the United States relatively recently and the many and unusual uses to which they and other older plants have been put. This is an unusually fine book for the high school library and a splendid supplementary reading for the biology and chemistry student, and the science teacher as well.

—R. J. A.

BENNETT, HUGH HAMMOND. *Elements of Soil Conservation*. New York: McGraw-Hill Book Company, Inc. 1947. 406 p. $3.20.

This new textbook will appeal to teachers and students and from its use may come better care of the land resources of our wonderful country—the United States, and other countries of the world as well.

I predict that in the next two decades more will be done toward soil conservation in the United States than in any five previous decades. The gulley-problem can't wait, something must be done about it.

It is difficult to keep the Mississippi river dredged out to a depth of fourteen feet; it silts up its bed so rapidly. This means our land is washing away by the way of gullies—our good, rich land is being wasted and misused. Farmers work hard to make a living; they need some outside help in conserving the soil.

I would suggest that the state use surplus money to pay a man selected from the community high school and pay young students to work under him during the summer months to stop gullies. With the farmers' consent they would cut brush and make brush dams and rock dams where needed on his farm. They would work hard eight hours a day at a much lower wage than that paid to farm labor. Young boys cannot accomplish as much as men so should be paid less. The idea isn't "Santa Claus"—big wages for very little work done. The plan has the advantage not only of conservation of land, but the boys through hard work would learn to work for their upkeep. It will prevent juvenile delinquency and idleness in both rural and town areas.

Boys twelve to sixteen years of age would be eligible. The digging of post holes, cutting and setting posts to anchor brush and rocks in forming the brush dams would make up the major part of their work. The knowledge gained about soil care from such a textbook as this would be of invaluable aid to such a group. They would travel in small groups and one truck would be sufficient for their camping outfit. They would carry along their bedding and cook and prepare most of their own food.

In this textbook there are pictures and diagrams showing how the gulley dams are made. In hilly, subsistence farm areas continual effort and vigilance is necessary if the land is prevented from washing away. Brush dams would not only prevent this but also help to store up and conserve moisture and prevent floods in downstream areas.

Some good features of this textbook are the very complete content page and the questions given at the end of each chapter. Also the list of films available to be used in connection with each chapter are suggestions which may prove of interest and value in the presentation of a course in Soil Conservation. The author of the textbook is Chief of the Soil Conservation Service in the United States Department of Agriculture, Washington, D. C.

—F. M. D.

FUCHS, WALTER M. *When the Oil Wells Run Dry.* Dover, New Hampshire: Industrial Research Service, 1946. 447 p. $3.75.

From the days of prehistoric man to the age of atomic disintegration, black gold has played a part in shaping the destinies of man. Men have fought and died for it. Fortunes have been won and lost over it. Today no nation can be a world power if it lacks access to it. Oil has become such an important factor in our everyday lives and in our national economy and safety that it is with real apprehension that we view the future. For what will happen when the oil wells run dry—when all of our known proved reserves are used?

This is an interestingly written story of oil—its past, its present, and its future. Few if any better accounts have been written. It is an excellent book for the high school library, the science teacher, the science student, and the laymen.

Possible future sources of petroleum products include coal, alcohol, oil shale, and vegetable oil. Other possible sources of power include energy from the sun, water power, winds, tides, electricity from air and clouds, and atomic energy.

—F. M. D.

EDITORS OF LOOK. *Oil for Victory.* New York: Whittlesey House, 1946. 287 p. $3.50.

Many factors and many materials contributed to the ultimate victory in World War II. No one will deny that oil was one of the most important factors, if not *the* most important. For example, it took 60,000 gallons of gasoline a day to keep a single armored division fighting; the larger bomber raids over Germany used up to 10,000 gallons of toluene a minute; one fuel tank of a battleship requires enough oil to heat a home for 500 years. Unquestionably oil powered the arsenal of democracy.

During the war the U. S. drilled 13,400 wildcat wells, produced 5 billion barrels of crude oil (one fifth of all the oil ever produced in this country) produced another three quarter of a billion barrels abroad, and built nearly a billion dollars of new refining facilities.

This story of oil in victory and peace is supplemented by many unusually fine and striking photographs and illustrations. A story of oil, it is at the same time a description of America's war efforts. The book is recommended for the high school science library, the chemistry teacher, and the layman. —F. M. D.

HICKS, GRANVILLE. *Small Town.* New York: The Macmillan Company, 1946. 276 p. $3.00.

Evidently many people prefer to live in small towns—otherwise why so many small towns? Many others prefer urban centers, and still others rural life. Granville Hicks, describes here what the people of one small New York town (Roxborough, near Troy) talk about and think about, their opinions and morals, their religion, education, economic patterns, and political life. People who have lived, or now live in small towns, will enjoy Mr. Hick's experiences—exciting and monotonous, pleasant and unpleasant, bitter and sweet. So appealing is the small town to the author that he would be most reluctant to live any other place.

Altogether *Small Town* is a study in the social sciences interestingly told by one who has taken an active part in almost every phase of its life despite a serious political if not social and economic handicap. —C. L. D.

SCARLETT, WILLIAM (EDITOR). *Toward a Better World.* Philadelphia: The John C. Winston Company, 1946. 184 p. $2.00.

Twelve distinguished Americans discuss how can Christian people, both as individuals and as church members, colloborate in building a better world. They discuss their beliefs in relation to urgent national and international issues: our diplomatic role toward Russia, racial minorities including the Negro question, full employment, and control of the atom bomb. Chapters are contributed by William Scarlett, Angus Dun, Sumner Welles, Reinhold Niebuhr, Eleanor Roosevelt, W. Russell Bowie, Edward L. Parsons, Edward Heinmann, Frances Perkins, Stringfellow Barr, William Ernest Hocking, and Arthur H. Compton.

—C. L. D.

HUGHES, RAYMOND M. AND LAUNCELOT, WILLIAM H. *Education—American Magic.* Ames, Iowa: Iowa State College Press. 1946. 189 p. $2.50.

The part of this book that is of most interest is the development and application of a new scale for rating state school systems. The results the authors get by the application of their scale vary so much from the results obtained by using the Ayer's scale, or any of its variations, the question of the validity of either scale is raised. This is not the place to examine critically either scale, but perhaps the time is past due for such an examination.

The authors use six criteria for their scale. They are: (1) accomplishments; (2) ability to support education; (3) degree in which their accomplishment is commensurate with their ability; (4) degree of effort; (5) efficiency of

their educational effort; (6) educational level of adult population.

Byron Newton has made some changes in the Ayers Scale which seem to be definite improvements. Using the ranking of the states by Newton and comparing them with the authors', we can see just how different the results are. The first column is the rank order of the states obtained by Hughes and Lancelot; the second column is the rank order obtained by Newton.

	Authors	*Newton*
Utah	1	12
Kansas	2	22
Oregon	3	13
Nebraska	4	16
Washington	6	21
California	7	2
Idaho	8	26
New Hampshire	9	23
Colorado	10	24
North Dakota	11	31
Nevada	12	11
Oklahoma	12	36
South Dakota	14	17
Massachusetts	15	4
Montana	16	9
New York	17	1
Wisconsin	17	8
Vermont	19	28
Indiana	20	30
Minnesota	21	15
Wyoming	22	20
Ohio	23	6
Maine	24	29
Texas	25	34
Illinois	26	5
Michigan	27	14
North Carolina	27	39
Connecticut	29	7
Missouri	30	32
Arizona	31	38
Pennsylvania	32	18
Tennessee	33	41
New Mexico	33	40
South Carolina	35	45
Louisiana	36	42
West Virginia	37	33
Mississippi	38	48
Kentucky	38	46
New Jersey	40	3
Alabama	40	47
Virginia	42	37
Arkansas	43	44
Rhode Island	44	25
Florida	45	35
Delaware	46	10
Maryland	47	27
Georgia	48	43

In addition to this scale and its application to the various states, the volume contains a number of other worthwhile chapters. The volume as a whole has not been hastily written. It represents a great deal of painstaking statistical work. It is well worth reading.

—N. CONGER

HOYMAN, HOWARD S. *Health Guide Units for Oregon Teachers.* (Grades 7–12.) (Limited number of copies available free from Author, University of Oregon, Eugene, Ore.), 1946. 429 p.

Oregon State law (House Bill 53) requires instruction in Personal Hygiene, Nutrition, Mental Health, First Aid, Safety, Communicable Diseases, Physiology of Exercise, Community Health and Sanitation, Structure and Functions of the Human Body, Choice and Use of Health Services and Health Products, and Effects of Alcohol and Narcotics. A carefully planned program of Health Education is contained in this syllabus, prepared under the supervision of a State Joint Committee for Health and Physical Fitness, of which the author is a member, and which includes representatives of the teachers colleges, universities, the State Board of Health, State Department of Education, State Medical Society, and State Nurses' Association.

Hoyman considers the plan to have several unique features:

I. Forms for teacher-rating and report of experience with teaching of each unit, with suggestions for improvement in future editions of the syllabus.

II. Four-cycle plan of health instruction: each of the areas specified by law (above) is given major instructional emphasis in each three-grade section of school, grades 1–12. For example, Nutrition is given major emphasis in grades 1, 5, 8, and 11. There is adaptation to different types of teachers and to differnt kinds of schools and communities.

III. Teacher Guide Units: five parts in each unit: Introduction—data on health and safety; Objectives; Outline—content and activities; Evaluation—"more comprehensive and specific than any health units published to date; Materials—"selected on the basis of objectives, content and activities, *not* a random collection of available teaching aids."

IV. Family-life and social hygiene education: in appropriate units for junior and senior high school, "conducted in a way to avoid sensationalism and 'special sex lecture' approach. An objective scientific approach will be used; however, the interpretation will be made from the standpoint of human values and ideals and *without violating the beliefs, standards, and creeds of specific religious groups.*" [Author's italics.] "The teacher *should not include* the three following topics: birth-control, venereal-disease prophylaxis, sexual techniques."

From a careful examination of this syllabus, this reviewer considers it to live up to its author's claims.

—M. E. O.

JONES, HOWARD MUMFORD. *Education and World Tragedy.* Cambridge: Harvard University Press, 1946. 178 p. $2.50.

This is a book of unusual timeliness and is well-written, as one would expect from the pen of Professor Jones.

He surveys the gruesome destruction from war of the last fifty years. The staggering totals of the casualties are stupefying. And what is even more bewildering is the fact that most of these wars of the past fifty years took place in Europe and the Americas—a product of our boasted Western Culture.

He points out that modern war is dependent on education as it has never been before. The officers are highly trained in the technique of war; the Private must have a minimum of a fourth-grade education; ninety per cent of all enlisted men must have special training beyond basic military; the production of all types of war equipment calls for highly specialized knowledge and skill. In other words, modern war is planned and fought by educated men. Our western civilization has the necessary mastery of science and technology to make war effectively—the colleges and universities are geared to science and technology. It is in the social sciences and humanities that they are deficient. This lopsidedness in our educational program is recognized by many educators. Numerous proposals have been made for correcting this imbalance.

After reviewing these various proposals and their conflicting philosophies, Dr. Jones presents his program which, as he says, "is not for eternity, but only for the next decade or two."

He then passes to what may be the bottleneck in all the efforts to correct the present situation, namely, the *teacher.* A consideration of this weakness leads into a discussion of the high departmentalization of our colleges and universities which make the graduate programs so fragmentary that students do not get the kind of education needed to teach general courses to undergraduates.

Dr. Jones makes a definite proposal for a type of organization and a type of program that should correct the condition now prevailing. It is to be hoped that graduate deans, especially, will read this section of the book and take it to heart. The entire book is well-written, and deserves to be widely read, not only by educators and administrators in the field of education, but by laymen as well. —N. CONGER

STRANG, RUTH. *The Role of the Teacher in Personnel Work.* New York: Bureau of Publications, Teachers College, Columbia University, 1946. 497 p. $3.75.

This book makes a definite contribution to the literature on counseling. Methods of discovering pupils' needs, desirable organization for personnel work, resources available to teachers, classroom conditions essential to good guidance procedures, the homeroom as an opportunity for guidance, utilizing student activities in the guidance program, and the teacher as counselor are topics discussed comprehensively and sensibly in a manner that will enable most teachers to function more effectively as a part of the counseling program of a school.

Section III, "Technics of Personnel Work," deals concretely and helpfully with such aids to observation of pupils' behavior as informal observation, anecdotal records, behavior journals, sampling an individual's behavior in a variety of situations, periodic summaries to discover developmental trends in behavior and personality, rating scales, daily schedules, autobiographies, psychological tests, projective technics, interviewing, and case study technics.

Although this is one of the best books that the reviewer has read on personnel, counseling, or guidance, he feels that it, like all the others, is inadequate in that it fails even to indicate the necessity for counselors and guidance workers to be adequately equipped in an understanding of the basic biological, health, psychological, and social sciences that underlie human physique, growth, motivation, learning, behavior, and personality. The fundamental weakness of all guidance programs lies in the inadequate professional competence of teachers and others who are endeavoring to administer them. The curricula for teacher education need to be revised to develop competence in the area of the sciences underlying human development and personality. —GUY A. LACKEY

SARGENT, PORTER. *The Continuing Battle for the Control of the Mind of Youth.* Boston, 11 Beacon St.: Porter Sargent, 1945. 160 p. $1.00.

This book is a reprint of the first 160 pages of the 29th edition of the *Handbook of Private Schools.* Like others of Sargent's books, this one takes a broadside at educational policies, theories, practices, persons, groups, and institutions in the United States. About half of the content consists of quotations from various prominent writers, interspersed with the keen, critical comments and evaluations of the author. Most of these comments and criticisms are negative in nature, and the reader is likely to be left in the dark as to what Sargent's own positive views, if any, are. His essential belief seems to be that educators and educational institutions should be free to follow policies and practices that will make it possible for individual students to develop their own potentialities for individual and social usefulness to a maximum degree.

The following quotation from George W. Martin, used on pages 114–15, seems to summarize Sargent's philosophy: "The great fundamental right in the world is the right to be wrong: to differ with the majority, and to say so blatantly and offensively. This may not con-

duce to popularity; but it makes for an interesting existence, and adds to the great hilarity. This tolerance is of the very stuff of which democracy is made, and the condition on which alone truth may be found. For once it is assumed, or successfully insisted, that any one group or government is the repository of all true knowledge and wisdom, then there is an end to further discoveries of truth. Where there is no right to be wrong, there is no education—only indoctrination; no art—only blueprints; no reason—only threats and force."

The following generalizations summarize the main ideas in the book: Private initiative loses its opportunities, and educational institutions tend to become static as education becomes more socialized and tax supported. Social and economic changes produce new pressure groups which endeavor to control education, and to use indoctrination as the chief means of doing so. Certain groups distort and misinterpret the historic and contemporray picture of society in an effort to maintain the *status quo*. Regimentation and conscription of youth are utilized further to centralize and perpetuate vested interests and privilege.

The book is informative and stimulating to thought and research. It reveals the wide range of information and the keen, critical mind of the author. It is well worth the careful study of every person interested in American culture and education. —GUY A. LACKEY

CLAWSON, JOSEPH. *Psychology in Action*. New York: The Macmillan Company, 1946. 289 p. $4.00

The author formulates fifteen principles, supported by evidence from case studies and other research, which he thinks underlie human behavior and explain it. His contention is that the chief aim of psychology is to enable the persons who master it to change the behavior of other people.

After defining a value as "whatever is wanted," he proceeds to formulate the principles of psychology around these values. Man's way of life consists of his values, which may be classified as: physical, 63 per cent; economic, 12 per cent; social, 11 per cent; intellectual, 7 per cent; political 1 per cent; religious 1 per cent; and general, 5 per cent. The relative importance of these different classes of values is for American culture, and is based on data from advertising.

The author formulates fifteen "great principles" under five major headings as follows:

I. *Value Principles.* (1) Man's tendency to seek pleasure and avoid pain is his basic and strongest motive; (2) values are things or ideas consciously or unconsciously adopted as the means of acquiring pleasures and avoiding pains; (3) all striving in life is an attempt to acquire and keep these values and to put them to work in acquiring or keeping other values; (4) all these values are changeable except the physical, and even they may be modified; (5) each individual has his own system of values which is in a flux and which functions as a pattern, yet his attention is likely to be focused on only one constellation at a given time; this limited constellation consists of the cost, means, goal, further, and tie-in values; (6) the appeal must begin with the respondent's hopes and fears, turning later on how he may realize them or quiet them and how much it will cost him to do so.

II. *Situation Principles.* (7) whenever a person finds one of his values in a situation other than possession (possible acquisition, possible frustration, possible loss, or possible rescue), he will exert himself to reach or return to the situation of possession; (8) thus, the "have-nots" will always strive to get, and the "haves" will always strive to keep; (9) the only way in which this drive to get and keep valuable things may be permanently altered is to change the things which a person wants; (10) whatever cultural values may flourish, they must not permit or cause the large-scale, continued frustration or loss of physical values.

III. *Value Balance.* (11) striving is greater when incentive is greater; (12) one adds all the advantages of an action and subtracts the disadvantages; the remainder represents the net incentive; the greater the net incentive, the grater the exertion which it produces.

IV. *Acceptance or Rejection of Means (Convictions).* (13) human nature is changed every time a person accepts or rejects some idea or thing as a means to an end; (14) the most penetrating form of conviction is first-hand experience; the most efficient form is second-hand experience.

V. *Completeness.* (15) All of the twenty-two elements which enter, aid, or condition the complete psychological appeal must be in good working order or the appeal may collapse. These twenty-two elements are: necessity for respondent to: (1) adopt the suggested means and value, (2) lack the value involved in the situation, (3) lack a more urgent value situation to be attended to, (4) lack alternative values for accomplishing the same purposes, (5) lack conflicting values, (6) have ability to respond, (7) have adequate perception, (8) be suggestible; the appeal must (9) present the situation, must specify (10) the persons involved, (11) the means to be used, (12) the setting of the situation, (13) the time of the situation, (14) the value-balance, (15) the chance—in the judgment of the respondent—that the situation did or will occur, (16) the acceptance (or rejection) of the proposed means, (17) ability of the benefactor (or depriver) to carry out the situation, (18) cause, reason, or justification for the situation, (19) belief in accuracy of stimuli received, (20) emotion (when presented as a part of the appeal), (21) intention of the beneficiary

(or victim) to respond as desired, and (22) specific instructions as to the response.

The necessity of applying these sound psychological principles in the solution of all individual and social behavior problems is emphasized.

Although one may question the validity of the use of advertising "results" as a means of determining the relative importance of human values, the "value-situation" theory and the set of principles evolved seem valid and useful in our efforts to understand and influence human behavior. The book is well worth reading, studying, and discussing.

—G. A. L.

BAKER, EMILY V. *Children's Questions and Their Implications for Planning Curriculum.* New York: Bureau of Publications, Teachers College, Columbia University, 1945. 184 p. $2.35.

This is the report of an investigation made "with specific reference to the contribution of the natural and social sciences in the intermediate grade curriculum." A basic assumption of the study from educational theory is that children's interests as expressed in their questions bear implications important for curriculum planners.

Questions were collected in sixteen cities, varying in population from 1,000 to 576,000, in various parts of the United States. In twelve public schools, the questions were obtained by the investigator herself; from the others, by cooperating teachers with uniform directions to be read to the children before they wrote their questions. Altogether 1,402 children submitted 9,280 questions, which were then classified under 33 categories, such as, Animal Life, Astronomy, Distant Lands and Peoples, Human Body, Music, Recreation, Travel and Transportation. Children's questions as classified are listed (pp. 20–105); there follows analysis as to total number of questions asked in each category, number of children who asked questions in each; on each basis the same categories are in the upper third in frequency of questions in all cities, also for middle third and lowest third; there is considerable similarity in the interests of boys and girls; Animal Life, Industries, and Commercial Products rank highest in the third grade and remain high throughout the grades included (up to sixth), the breadth of interest increases in the upper grades.

The chapter on "Interpretations and Implications" includes the factors affecting the nature of the questions asked; implications as to teacher needs in the subject matter of areas emphasized in children's questions, including the social sciences, current events, economic geography, natural sciences, and implications as to teacher needs in areas neglected in children's questions so that new vistas may be opened and new interests fostered. Perhaps children need more opportunities to manipulate materials, to experiment with colors, to construct simple instruments, and to use modern ones. . . . Doubtless many well-meaning teachers—experienced as well as inexperienced—ignore or otherwise stifle children's questions because they do not know how to answer them. . . . Children can ask questions that are as thought-provoking and as sensible as those asked by teachers." [The reviewer can't refrain from commenting on the similarity to his study—in press—*Children's Explanations of Natural Phenomena.*]

Nearly half the questions fall in areas considered as the social studies; nearly two-fifths call for scientific information; only 3.66 per cent of the pupils asked questions about their local communities.

The problem of the education of teachers is given repeated emphasis in this report. Teachers of biology will find it suggestive as to their responsibility to children in the intermediate grades; teachers in any area will find this volume stimulating reading.

—M. E. O.

HURD, ARCHER WILLIS. *Building a Course Within a Professional Curriculum.* Richmond, Virginia: Bureau of Educational Research and Service, Medical College of Virginia, 1947. 59 p. $.79.

This is the fourth book of a series whose over-all objective is a study of a basic curriculum for the preparation of nurses. However, the entire series has many applications useful in other professions such as teaching. That is especially true of this book. It stresses procedures which may be used to integrate sociological, psychological, and communication phases into one offering. It gives also some suggestions on instructional methods for conducting theory, as contrasted with practice, courses.

An extensive list of generalizations have been set up under the following headings: (1) Foundations of human society, (2) The reactions of society and the individual, (3) Social functions and relationships, (4) Economics of social life, (5) Some aspects of family and marriage, (6) Delinquency, crime, ethics, religion, (7) Group psychology, (8) Social intercommunication, (9) Use and abuse of language, (10) Nursing and health records, (11) Biological foundation of behavior, (12) Psychological aspects of personality and behavior, (13) Perception, habit, motivation, attitudes, adjustment, (14) Some psychological implications for care and prevention, (15) Some reflections on mental illness, (16) The nature and process of education, (17) Some aspects of learning capacity, guidance, and permanence of learning, and (18) Science, nursing, and other aspects of functional education.

Part III discusses how to make use of the principles and generalizations in class meetings.

—C. M. P.